LETTER OF TRANSMITTAL

Raleigh, N. C., June 30, 1915.

To His Excellency, Locke Craig,
Governor of North Carolina.

Sir:—I have the honor to transmit herewith the report of the operations of the Agricultural Experiment Station, conducted jointly by the North Carolina Department of Agriculture and the North Carolina College of Agriculture and Mechanic Arts, for the year ended June 30, 1915.

Very truly yours,
B. W. Kilgore,
Director.

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THIRTY-EIGHTH ANNUAL REPORT

OF THE

North Carolina Agricultural Experiment Station

For the Year Ended June 30, 1915

B. W. Kilgore, *Director.*
F. H. Jeter, *Agricultural Editor.*

This report covers the work of the Station from July 1, 1914, to June 30, 1915.

During this period, plans for carrying on experimental work under the "Joint Committee for Agricultural Work" of the State Department of Agriculture and the College of Agriculture and Mechanic Arts were perfected and put into operation. The Extension Service, which is also under the control of the "Joint Committee" and which was formerly a division of the Station, was organized as a separate service. It is now being conducted in close coöperation with the Station Workers and, because of this close association, is better enabled to take the facts found by experiments to the farmers of the State. All work under the "Joint Committee" is carried on in coöperation with the United States Department of Agriculture.

Very few changes in the staff have occurred, and these have all been of a minor nature.

During the year another branch station has been added to the chain of substations over the State. This is the Washington County Farm, located in the black land district of the Coastal Plain. Studies have been inaugurated on this farm in regard to soil treatment, fertility investigations and variety tests. The importance of this station can hardly be overestimated on account of the many acres of land in North Carolina yet to be reclaimed and put under cultivation. Improvements to the value of $3,500 have been made to the property of the Station. Most of these improvements have been done on the branch stations in the form of new buildings.

The undertakings in which the various Divisions and workers are engaged are given in the reports from the different Divisions.

WORK IN THE AGRONOMY DIVISION.

The work of the Division of Agronomy is being continued under five main heads—soil chemistry, soil fertility, plant breeding, soil survey and miscellaneous. Special work has also been taken up in the study of soybeans and cowpeas with a view to improvement of the varieties and extension of growth, especially of the soybean. This State is now the largest producer of soybeans in the Union. The crop has

been largely used for seed only, though this season considerable quantities have been worked by the cotton seed oil mills for the oil and cake. Increased work is also being taken up with the small grains of the State.

Considerable progress is being made in the preparation of a soil map of the State. During the year five counties have had detailed soil survey maps made. Field experiments with soils, chemical analyses, and microscopic studies of the various soil minerals are being made with a view to determining just what minerals present in our various soils furnish plant food and what is the condition of these minerals in the different soil types.

A large amount of tobacco work is being conducted on the special branch station, which was established three years ago. This work is being done in connection with the Bureau of Plant Industry.

WORK OF THE DIVISION OF CHEMISTRY.

The work of the Division of Chemistry is being continued along the same lines as heretofore. Special investigations as to the toxicity of cotton seed are being continued. During the year the Division has succeeded in determining this toxic principle to be Gossypol. Data is also being collected in regard to the antidotes for toxicity of cotton-seed meal when fed to pigs. Work in this connection is being done with copperas solutions, ferric chloride solutions, and ashes.

The plots under experimentation by the Division of Agronomy are being studied for nitrification. This work is being done in coöperation with the Division of Bacteriology and samples are being taken from the plots at stated intervals during the year.

WORK OF THE DIVISION OF ANIMAL INDUSTRY.

The investigational work of the Division of Animal Industry is carried on under the general heads of Swine, Beef Cattle and Sheep, Dairy investigations, Poultry, and Horses and Mules. Work is being continued and extended in the study of the effects of different feeds upon the composition and quality of the bodies of animals. Especial consideration is given to hogs, sheep and beef cattle. With hogs, studies are being made of feeds which will overcome the soft pork produced by feeding soybeans and peanuts.

A considerable amount of work has also been done with cheese. A study of methods of manufacture is being conducted in the western part of the State. Some good results have been obtained in this work and four cheese factories have been established for the manufacture of cheese on a commercial scale. On account of the long distances away from the railroads that most of the farm homes in the western section of the State are it has been found that the profits in keeping dairy cattle are materially increased when the milk is marketed in the form of cheese. This work is being conducted in coöperation with the Dairy Division of the Bureau of Animal Industry.

The Poultry work of the Station has now been made a part of the Animal Industry Division and a considerable amount of experimental work has been inaugurated.

With horses and mules, a study is being carried on for the purpose of determining the place of cotton-seed meal in a ration for work horses and mules.

Work in the Division of Entomology.

The general oversight of insect control and investigational work on the seven test farms (branch stations) was assigned to this Division in 1914, and the work includes the general spraying work with the orchards on these farms, the control of borers, and advising in case of insect outbreak or emergency. The fruit crop on these farms was remarkably free from insect injury during the years under consideration.

Special investigations are being conducted as to the insect life of North Carolina, and numerous facts and specimens have been placed on record. Five separate tests are being conducted in spraying peaches in which all "drops," from the time the fruit is "set" until picked, are examined. Work is also being done with corn stalk borers and in potato spraying and flea beetle control.

The commercial growing of the pecan is becoming an important industry in the State now, and through the work which has been inaugurated, much light has been thrown on the habits and life history of the pecan insects.

Preliminary work is being conducted with the cowpea weevil for the purpose of taking up this work actively when the corn-bill bug project is finished this year. Considerable study has been devoted to the corn-bill bug and the results of control measures used in previous years have been further authenticated. Studies made in the laboratory have been borne out by the results of field experiments.

Progress is being made in a study of the gloomy scale. Considerable work has been done in the life history of the scale and its parasite.

Work in the Horticultural Division.

The Division of Horticulture has spent considerable time on the culture and general management of the pecan crop. The orchards on the Eastern Test Farms have materially increased in production and breeding work has been inaugurated with a large number of varieties under observation. Five hundred seedlings were set out during the year as a result of crosses made by pollination.

In coöperation with the Bureau of Plant Industry the work with muscadine grapes is also being increased and over eighteen acres of land is now devoted to the various phases of the cultural, pruning, trellising, fertilizer, and hybrid testing work. The work in the study of the transmission of characters in hybrids of muscadine grapes has been extended along several lines, and some results obtained indicate that early improvements will be made in varieties of this class of grapes.

Sixteen varieties of blackberries and fifteen varieties of dewberries are being studied in the work being carried on in a study of the self-sterility in blackberries and dewberries. A report of this work is now being written and will soon be ready for publication.

Investigations on the phenomena of thermal belts are being carried on with fifteen observing stations located at various points on the orchard slopes in the mountains of western North Carolina.

Some peach work has been inaugurated and the work with vegetables is being continued and extended.

WORK IN THE DIVISION OF VETERINARY SCIENCE.

Investigations for the past year in the Division of Veterinary Science have been conducted in a study of the disease commonly known as "contagious abortion." A result of the study points to the fact that this disease is, along with others, caused by a venereal infection and that abortion is only one of the symptoms. The disease is general over the State.

Considerable time has been spent by the division in making microscopical examinations of pathological tissues and in identifying animal parasites which have been sent in from all parts of the State.

WORK IN THE DIVISION OF PLANT PATHOLOGY.

In coöperation with the Division of Chemistry, the Division of Plant Pathology and Bacteriology has continued work during the year for the study of the nitrification activities of specific soil organisms and of the bacterial flora of particular soils. A study of peanut diseases has also been begun during the same period.

Progress has been made in the study of apple root rots and four organisms have been isolated that are suspected of causing as many distinct types of the rot. Wilt control work is being carried on with tobacco and watermelons. Definite soil treatment, rotations and breeding work are being done at Creedmoor in an effort to control the wilt disease of tobacco. Efforts are now being put forth to discover a canning type of tomato that will be resistant to wilt.

Cotton disease work with anthracnose and wilt is being carried on in coöperation with the plant pathologists of other stations.

WORK IN THE DIVISIONS OF MARKETS.

The Division of Markets is sending out each week a price report of various farm products that are sold in the State. In addition to this, sellers, buyers, and receivers of farm products are being listed in a *Farmers' Market Bulletin* for the purpose of aiding the farmers to dispose of their surplus production to reliable firms.

Aid has been given in the development of organizations for grading and marketing potatoes, corn, soybeans, and strawberries. This work is being done for the purpose of helping the producers to so organize that they may standardize the pack of their products so as to guar-

antee the grade and maintain the product upon a market in competition with the same product from other communities.

In connection with the work of grading and stapling cotton, investigations have been carried on to determine how far the cotton grown in the State meets the needs of North Carolina mills. Five grading offices have been organized at Tarboro, Wilson, Goldsboro, Charlotte, and Nashville.

Investigations of credit conditions in the State have shown that the limited and high-price credit system followed is a serious hindrance to the development of agriculture. Under the present system the adoption of improvements is very difficult. Credit unions are being organized among farmers.

PUBLICATIONS.

The following publications have been issued during the year:

Bulletins:

No. 228—Air-cooled Apple Storage Houses.
No. 229—Fertilizer Experiments with Corn on Piedmont Cecil Sandy Loam Soil, and Varieties, Culture, and Fertilization of Corn on Piedmont Cecil Sandy Loam and Red Clay Soils.
No. 230—Variety Tests of Corn, 1914.
No. 231—Variety Tests of Cotton, 1914.

Circulars:

No. 20 Rape for Hog Pasturage.
No. 21 Improving Cotton by Seed Selection on the Farm.
No. 22 Beef Cattle Producion.
No. 23 Not Issued.
No. 24 Soybean Pastures for Hogs.
No. 25 Feeding the Sow and Suckling Pigs.
No. 26 Pig Club Manual.
No. 27 The Limitations of Cotton-seed Meal Feeding in Poultry.

Farmers Market Bulletins: 7 issues.

REPORT OF THE DIVISION OF AGRONOMY.

To the Director:

I herewith transmit the report of the Division of Agronomy for the fiscal year ended June 30, 1915.

The work in agronomy has been conducted along the lines as previously reported, which are as follows: (1) Soil Chemistry; (2) Soil Fertility; (3) Plant Breeding; (4) Soil Survey; and (5) Miscellaneous.

SOIL CHEMISTRY.

For many years it has been felt by this Division that a more thorough knowledge of the amounts of various plant food constituents of the different types of soil occurring in the State would be of the highest importance in advising farmers with reference to the plant food requirements of their soils for different crops. With this information at hand and that afforded by our carefully conducted field tests, much light may be thrown upon the problems of soil fertility. It is chiefly along these lines that we have been carrying on the soil investigations in North Carolina for a number of years, and it is believed that much progress has been made in solving many of the problems connected with a better system of agriculture for our State. We feel that it should ever be kept in mind that the fertility of our soils is the basis upon which the material progress of our people is to be made, for when the soils of the State fail to produce remunerative crops then it will be that all our industries will begin to suffer.

During the year 408 samples of soil have been taken in soil survey investigations. The nitrogen and phosphoric acid have been determined in all of these and a complete chemical soil analysis has been made on 103. Mineralogical analyses have been made on 134. One hundred and six samples of soil for 46 farmers have been examined chemically and mineralogically and letters have been written based upon the analyses recommending the fertilizer treatment for their particular soils. Twenty-six identifications of rocks, minerals and other specimens have been made and a chemical analyses of 22 limestones and marls have been completed. During the past year a bulletin giving the results of some of the mineralogical examinations of the soils of various areas of different sections of the State has been prepared and published. It is believed that the matter contained in this bulletin will not only be of considerable scientific value, but will be of immense practical value to us in the interpretation of field results we are securing with different crops grown in an experimental way on different types of soil in various parts of the State.

The chemical analyses of the soils examined in the eastern part of the State remain yet unpublished, but it is planned to bring these together during the next year for publication. It is strikingly remarkable how closely the field results obtained from the experimental plots agree

with the facts brought out by the chemical and mineralogical examination of the soils with reference to their fertilizer requirements. The chemical analyses are of value in determining the total amount of various elements of plant food which the soil contains, while the mineralogical analyses, supplementing the chemical analyses, have shown to a great extent the forms in which the plant food constituents are combined and have served to explain in many cases field results that it would be very difficult or impossible to understand had we not these analyses at hand.

The soils of the Mountain and Piedmont sections of the State are, as a general rule, better supplied with potash and lime than are those occurring in the Coastal Plain section. The amount of phosphoric acid present in most of the soils of the State is very low, and is therefore in many cases the limiting factor in crop production on many of the well cultivated soils of the Piedmont section in particular.

SOIL FERTILITY INVESTIGATIONS.

During the year soil fertility investigations have been conducted at the Buncombe, Iredell, Granville, Edgecombe, Pender, Washington and Central farms. In addition, investigations designed to determine the plant food requirements of different types of soil have been carried on on seventeen important and distinct types of soil in different parts of the State. This latter work is conducted in coöperation with farmers, the Division maintaining a strict supervision over the work. It is remarkable the amount of valuable information that is being secured with reference to the plant food requirements of the leading types of soil from these latter investigations.

During the year soil type work has been started in Cabarrus County. The plats are located near Concord on the Mecklenburg clay loam type of soil. On this field, in addition to planning to establish the fertilizer deficiencies of the soil, it has been arranged to study the effect of kainit and sodium chloride in reducing rust in cotton. Farmers who have attempted to grow cotton in Cabarrus County on this type of soil have had the greatest difficulty in combating this disease. Two fields during the year have been established at the Pender Test Farm. Field A is a regular fertilizer experiment, designed to show the best rotation and the most economical fertilizer to use after a rational rotation has been established. A special feature in connection with these tests is to determine the effect of liming one-half of all the plats at intervals of four years.

Field E at this farm is a regular soil type test, put out on the Norfolk fine sandy loam type of soil.

During the spring an experiment was started at the Washington Test Farm to study the value of different fertilizer treatments with different crops on the peaty soils of this farm. In connection with the fertilizer experiment it is planned to establish a definite system of crop rotation. In this experiment there are twenty-five plats, each of

which receives a different fertilizer treatment. One-half of all the plats is to be limed at intervals of four years.

Among other things it is planned to study the relative value of basic slag in comparison with acid phosphate as a carrier of phosphoric acid. During the year two new plats were added to the soil type field at Blantyre to study the value of basic slag as a phosphoric acid carrier. As the rotation in practice on this field includes many cover crops which are to be turned into the soil, this carrier of phosphoric acid should have favorable conditions for showing its relative value as compared with acid phosphate.

It has been felt for some time that the farm-life schools of the State were excellent places at which to establish soil type work if the farms were located on important types of soil that were not yet being studied in an experimental way. The value of locating the work at these schools would be that there would be a large number of students present who would be particularly interested in the results from such experiments carefully conducted. Not only this, but material would be at hand for the alert teachers to use in bringing out the important matter of the plant food requirements of the particular types of soil on which the farm-life schools were located. During the spring, therefore, soil type work was started in connection with seven of these farm-life schools, located as follows:

Pleasant Garden Farm-life School, Pleasant Garden.
China Grove Farm-life School, China Grove.
Parrish Agricultural High School, Bahama.
Red Oak Farm-life School, Rocky Mount.
Lillington Farm-life School, Lillington.
Philadelphus Farm-life School, Red Springs.
Lowe's Grove Farm-life School, Durham.

The plan of the experiment carried on at these schools is practically that which is being used in the regular soil type work conducted with farmers, except that one of the plats in every case is to receive stable manure as a carrier of nitrogen.

A new regular fertilizer experiment was started at the Buncombe Test Farm during the year. On these plats a three year rotation consisting of Irish potatoes, wheat and red clover is being used. The experiment is situated on what is known as the Toxaway loam type of soil, which is one of the leading types of soil used by farmers in the mountains for growing potatoes for market. A particular feature of this experiment is a comparison of different carriers of potash, viz., manure salt, sulphate of potash, muriate of potash and kainit. This latter experiment is being conducted in coöperation with the Horticultural Division of the Station.

Work at the Buncombe Farm.—The fertilizer tests with alfalfa at this farm show from one year's work that lime and stable manure are essential on mountain soils deficient in organic matter if a successful

crop is to be secured. On Field D, plats 0-9, inclusive, acid phosphate is used showing somewhat better gains than is rock phosphate. On plats 10-13 of this field the rotation furnishing nitrogen from the growth of legumes is showing up very well. All the experiments at this farm are being carried on along the same general line as previously conducted. As a general thing, phosphoric acid in many soils has been shown to be the chief plant food deficiency except in the case of Porter's sandy loam, which has shown a greater need for nitrogen. Even with this soil phosphoric acid comes second in importance. Most of the soils of the mountains, especially when a rational system of rotation has been inaugurated on them, show considerable benefit from applications of lime.

Work on the Iredell Farm.—All the experimental work at this farm is being carried on along the same general lines as heretofore. In the Nitrolene test one year's results have been secured from which no definite conclusions can be drawn as yet.

Results at this farm as well as in other sections of the Piedmont section on the Cecil series of soils have shown phosphoric acid and nitrogen to be the chief plant food requirements.

Work at the Edgecombe Farm.—Here, as at the Iredell farm, the work has been conducted as in previous years. It is necessary to note that the Norfolk fine sandy loam type of soil of this farm, which is one of the leading types throughout the Coastal Plain section, has shown to be most in need of nitrogen for ordinary crops. Potash seems to be second in importance. This latter constituent makes its best showing, however, when used in connection with nitrogen, for when used alone it does not appear to give very much benefit with the non-leguminous crops.

Work at the Central Farm.—Experiments at this farm, as at the Iredell farm, have shown phosphoric acid and nitrogen to be the chief plant food requirements. The experiments as planned and reported on previously are being conducted without any modification or alteration.

Work at the Washington Farm.—At this time the crop on the fertilizer plats laid out during the spring is not ready to harvest, but observations would indicate strongly that lime is one of the chief requirements of the soil of this farm in its present condition.

Work at the Pender Farm.—The first crop from the fertilizer plots at this farm has not been harvested, but it is evident that lime in conjunction with the different plant food constituents shows a much larger growth of crop in nearly every instance than where the lime was not applied.

PLANT BREEDING.

During the year the work in plant breeding has been confined largely to corn, cotton, wheat, oats, cowpeas, soybeans and rye. For some time a study has been made of varieties of corn grown under different soil conditions in the State. It is felt that from this work

much information of value has been secured for the people of the State and for starting the breeding work on a more practical basis. There is no question but that the systematic breeding of all crops should be based upon the selection of seed from those varieties that have shown up in the different localities in variety tests to be the best yielders. During the past four or five years in variety tests with corn it has been shown that certain varieties have demonstrated their superior value for certain localities. The best yielders have been found to be, at the Edgecombe farm, Biggs Seven-ear, Weekley's Improved, Cocke's Prolific, Goodman's Prolific, and Hickory King; at the Iredell Farm, Weekley's Improved, Southern Beauty, Parker's Prolific and Biggs Seven-ear; at the Central farm, Sanders' Improved, Biggs Seven-ear, Cocke's Prolific and Weekley's Improved; and at the Buncombe Farm, Biggs Seven-ear, Southern Beauty, Cocke's Prolific, Hickory King, and Weekley's Improved.

The work with cotton has up to within the last two years been largely in the nature of determining the relative value of varieties when grown under different soil and climatic conditions in different portions of the State. More recently field selections from the leading varieties have been selected for breeding trials. As a result of the field tests of different varieties during the past ten or twelve years it has been found that for the soil of Edgecombe County, Shine's Early Prolific, Brown's No. 1, Russell's Big Boll, Sugar Loaf, Cook's Improved and King's Improved were among the most productive varieties; at the Iredell farm the most and most profitable yielders were King's Improved, Shine's Early Prolific, Cook's Improved, Russell's Big Boll, Brown's No. 1, Sugar Loaf, in about the order given were the best yielders; and at the Central farm Cook's Improved, Hawkins' Extra Prolific, Edgeworth, Cleveland Big Boll, Triumph, Culpepper's Reimproved, and Williams' Improved were among the leading yielders.

Considerable work during the year has been devoted to a study of the association and inheritance of the plant characters in cotton. This work has consisted of a study of the economic characters of the cotton plant. Special attention is being given to their mode of inheritance and association in the plant. This work was begun in 1913 by selecting fifty open-fertilized plants from a general field of King's Improved cotton growing on the College farm. Seed from these plants were grown in separate rows in 1914. Data has been collected on all the progeny of the fifty plants with reference to length of stalk, distance from ground to first branch, number of bolls, earliness, number of fruiting branches, number of barren branches and number of nodes. Farther studies are now being made on the size of boll, length of staple, percentage of lint and size of seed. Along with the above studies notes are being taken on the comparative vigor of the plants from open and self-fertilized seed. In coöperation with the Mississippi Experiment Station studies are being conducted to study the "place effect" upon cotton characters. The work has consisted of a comparison

of cotton plants grown in Mississippi with those from the North Carolina-grown seed, the original seed having come from one plant grown at the North Carolina station in 1913.

In the plant-to-row cotton breeding work at the Central farm during the past year, in which fifty-two strains of King's Improved cotton were tested, the yields of seed cotton per acre ranged from 777 pounds to 2,209 pounds per acre, the average yield for the entire lot being 1,454 pounds per acre. Seed from the general crop of King's Improved cotton in a separate field on the same type of soil and fertilized and cultivated about the same produced on an average of 1,050 pounds per acre. When the conditions on these two fields were not accurately comparable the data certainly indicates some progress from the selection. The plant-to-row work with Russell's Big Boll cotton at the Edgecombe farm and King's Improved at the Iredell farm is progressing in a satisfactory manner. During the year coöperative plant-to-row cotton breeding work with long staple cotton has been conducted on the farm of Mr. George C. Leach, of Aberdeen. There was a marked difference in the yield of the different strains grown at this farm. It is planned to continue this work for another year.

Coöperative work, too, has been conducted in Edgecombe County in coöperation with several farmers in the vicinity of Macclesfield.

During the year plant-to-row corn breeding work has been started on the farm of Mr. William Wyatt, Raleigh. At the time the work was requested it was too late to make field selections, so this year the work has consisted of selecting fifty ears of various types from a general lot of Wyatt's Yellow Dent corn. The variety was found to be badly mixed in regard to color, shape and size of ears and shape and depth of grains. Since the variety has been originated by the crossing of other varieties it was thought best to plant several types of ears in order to better make the comparison of the variety under field conditions. The chief object of this work is to produce an early and prolific strain of corn which is adapted to the conditions of central North Carolina.

Much work in the breeding of velvet beans, cowpeas, and soybeans has been carried on at the Central farm with promising results. Special grounds have been set aside during the year for conducting all the breeding work with these and other crops.

A number of varieties of soybeans, too, have been tested on the farms of F. P. Latham of Belhaven and W. T. Holderness of Tarboro. Both of these gentlemen have shown great interest in the results that are being secured in the tests.

SOIL SURVEY.

The soil survey work, conducted in coöperation with the Bureau of Soils of the U. S. Department of Agriculture, has been continued during the year along the same general lines of previous years. Two parties have been in the field all the time and for part of the time three

parties have been working. The work has progressed in a very satisfactory manner. During the year surveys have been finished of Union, Bladen, Wayne and Columbus, and work has been started in Anson, Alleghany and Davidson Counties.

MISCELLANEOUS.

The work with different individual grasses and grass mixtures put out two years ago in different parts of the State is being continued along the same general lines as previously reported. Much information of value with reference to different grass mixtures for hay and pasturage purposes is being afforded by these experiments.

During the fall coöperative experiments with the Office of Cereal Investigations of the U. S. Department of Agriculture were put out at the Buncombe and Iredell test farms. These experiments were designed to determine the comparative value of different methods of seeding oats and wheat at different rates of seeding, a comparison being made of the open-furrow method in comparison with drilling and broadcasting wheat and oats. During the spring arrangements were made for conducting with the Office of Forage Crop Investigations of the Bureau of Plant Industry a series of experiments with cowpeas and soybeans. In these investigations plats were planted which were designed to study the relative value of different varieties; of different methods of culture; of different rates of seeding; and of different times of planting of soybeans and cowpeas. These experiments are being conducted at the Buncombe and Edgecombe farms.

PUBLICATIONS.

During the year the Division has prepared the following bulletins and circulars:

No. 229—Fertilizer Experiments with Corn on Piedmont Cecil Sandy Loam Soil, and Varieties, Culture and Fertilization of Corn on Piedmont Cecil Sandy Loam and Red Clay Soils, by C. B. Williams.

No. 230—Variety Tests of Corn for 1914, by G. M. Garren.

No. 231—Report on Variety Tests of Cotton for 1914, by R. Y. Winters.

No. 20 (Circular)—Rape for Hog Pasturage, by C. B. Williams.

No. 21 (Circular)—Improving Cotton by Seed Selection on the Farm, by R. Y. Winters.

Bul. Vol. 36, No. 2 (Whole No. 206)—Report on the Piedmont Soils, by C. B. Williams, W. E. Hearn, W. F. Pate and J. K. Plumer.

I wish to take this opportunity to commend most heartily the loyalty and fidelity of my coworkers in the Division.

Respectfully submitted,

C. B. WILLIAMS,
Chief, Division of Agronomy.

DIVISION OF CHEMISTRY.

To the Director:

I have the honor to submit the following report of the Chemistry Division for the year ended June 30, 1915.

TOXIC PRINCIPLE OF COTTONSEED.

This Division has succeeded during the year in determining the toxic principle of cottonseed to be Gossypol. The following is a summary of the conclusions drawn from our investigations:

1. Gossypol, first isolated by Marchlewski from cottonseed oil and considered by him a prospective dyestuff, was extracted by us from cottonseed kernels and found to possess toxic properties.

2. Cottonseed kernels were used as the initial material instead of cottonseed meal, because they yield gossypol more readily to solvents and are toxic to about the same extent.

3. Ethyl ether was used as the solvent, the kernels having been extracted with gasoline to remove most of the oil. Evaporation of the ether leaves a crude product which we have designated "gossypol extract." A purer product, "precipitated gossypol," was obtained from the ethereal solution by the addition of gasoline, and a crystalline product, "gossypol 'acetate,'" by precipitation by acetic acid.

4. Gossypol was fatal to rabbits when administered intraperitoneally in the form of gossypol extract or crystalline gossypol acetate, either when fed in one large dose in the form of gossypol extract or when fed in small daily doses in the form of gossypol extract, precipitated gossypol, or gossypol "acetate."

5. Gossypol forms an oxidation product which is nontoxic.

6. Cottonseed kernels are rendered less toxic by the partial extraction of gossypol, and nontoxic by a more nearly complete extraction of it.

7. Methods for rendering cottonseed kernels nontoxic depend upon extracting the gossypol or changing it to physiologically inert forms by oxidation or by precipitation.

8. The smallest amount of gossypol administered intraperitoneally by us and found fatal to rabbits was 0.24 gm. of crystalline gossypol acetate per kilo of live weight.

It appears to us quite likely that gossypol is the cause of the low percentage of digestibility of the proteins of cottonseed meal.

It is quite probable that gossypol and raffinose occur in the root of the cotton plant.

ANTIDOTES TO THE TOXICITY OF COTTON-SEED MEAL.

During the year, with the collaboration of the Division of Animal Industry, four lots of nine pigs each were fed cottonseed meal mixed with other substances. The feed was supplied to the animals in each pen as a whole, so as to approximate more closely ordinary farming conditions. Copperas solution, ferric chloride solution, and ashes were

supplied to different pens. As in our previous experiment, cottonseed meal was found poisonous to pigs under the conditions of the experiment and iron administered in the form of ferrous sulphate (copperas) and ferric chloride diminished to some extent, but did not overcome entirely the toxic properties of the meal. Ashes, under the conditions of the experiment, had slight effect, if any, in this direction.

NITRIFICATION IN SOIL PLATS.

In coöperation with the Division of Bacteriology there has been a continuation of the study of nitrification in the soil plats which are under experiment by the Division of Agronomy, the samples being taken at stated intervals through the year. Data which we trust will be of considerable interest have been collected.

NITRIFICATION METHODS.

During the year this Division, with the collaboration of the Bacteriological Division, has studied various proposed nitrifying media with a view to using conductivity methods for studying the rate of nitrification in solution. We have found it desirable to modify somewhat some of these solutions with a view to avoiding changes in them due to interaction of their constituents, which changes are not connected with nitrification. We hope, as a result of these studies, to be able to ascertain the changes which take place in the same solution from day to day.

PAPERS AND PUBLICATIONS.

Before the Association of Official Agricultural Chemists in Washington, November 1914, a note upon "Gossypol the Toxic Substance in Cottonseed Meal" was presented. An abstract of this paper has appeared in the *Experiment Station Record,* March 10, 1915, and the full paper will appear in the *Journal* of the Association.

In *Science,* of February 26, 1915, appeared a preliminary note upon "Gossypol a Toxic Substance in Cotton Seed." Before the North Carolina Section of the American Chemical Society, April 19-20, 1915, were presented papers entitled "Gossypol the Toxic Substance in Cottonseed" and "Some Notes upon the Chemistry of the Cotton Plant."

Before the North Carolina Academy of Science, May 1, 1915, were presented papers entitled "Gossypol the Toxic Substance of Cotton Seed" and "The Significance of Gossypol in the Cotton Plant," the latter of which is abstracted in the *Journal of the Elisha Mitchell Scientific Society.*

The *Journal of Agricultural Research,* of November 15, 1915, contains a thirty-two-page article upon "Gossypol the Toxic Substance in Cottonseed Meal." This article contains four plates and embodies the results of our investigations relating to gossypol up to the time of publication except in regard to the chemistry of gossypol, which is almost ready for publication.

Very respectfully,

W. A. WITHERS,
Chemist, Experiment Station.

REPORT OF DIVISION OF ENTOMOLOGY.

To the Director:

In accord with your request, I present the following review of work on the Entomological projects under my charge for the year ending June 30, 1915. A definite list of these projects was filed with you March 31, 1915. In this report I shall discuss those which have connection with Experiment Station work.

1. INSECT CONTROL ON TEST FARMS.

The general oversight of insect control work on all the State Test Farms was assigned to this office early in the year 1914. This includes the general spraying work in the orchards on these farms, the control of borers, and advising in case of any insect outbreak or emergency.

During the year under review no special insect emergency has arisen on these farms. The fruit orchards have been regularly sprayed and have been kept in good condition so far as insect and disease pests are concerned. Am glad to say that the fruit crop of 1914 on these farms was reported to be exceptionally free from insect injury, and the same condition obtains with regard to the peaches which have so far been harvested in 1915. The control of Codling Moth and Curculio have been effective. The San José Scale has also been controlled, except for some injury on some old apple trees on the Granville Test Farm, which did not come under our control in time to admit of scale treatment in the early spring of 1914. Two or three peach trees on the Edgecombe Test Farm were removed because they had been weakened by borers. We feel that the work under this head has been successfully carried out. The persons responsible for the conduct of this project are Mr. S. C. Clapp, Assistant in Field Work, and myself.

2. PUBLICITY WORK.

(1) By Publications, (2) by Farmers Institutes and Other Meetings.

The work under this head is prosecuted chiefly in my connection with the State Agricultural Department, and does not call for extended discussion here. The Department's monthly *Bulletin* for May, 1914, is on "Insect Enemies of Corn," and is a revision and improvement on the one on same subject issued in May, 1904. The *Bulletin* for June, 1915, is on "San José Scale, Orchard Spraying, and Orchard Protection," and is a revision of the *Bulletin* of June, 1912. The original issues of both these publications have been exhausted. We also issued a smaller Circular on "Orchard Spraying," in October, 1914.

A number of Farmers Institutes have been attended, also a few other meetings.

The project is conducted by the Entomologist, assistants aiding in it to some extent.

3. ADMINISTRATION AND CORRESPONDENCE.

Under this head comes the great bulk of routine office work, supervision of work, inspections, expenditures, equipment, office consultations, etc. The Entomologist attends to most of this, the assistants being charged with a minimum amount of this work, so that they may give their time to specified projects. This work is mainly carried on in my connection with the State Agricultural Department.

4. EXTENSION WORK—ORCHARD INSPECTION.

This work is carried on chiefly through the State Agricultural Department, and consists in visiting and inspecting the fruit orchards of the State advising with owners or managers as to control of serious pests, spraying, and the like.

Comparatively little has been done on this project during the year, and I am able to specify the chief reason for this, they are: (1) The insect control work on the test farms, already discussed, takes a very large share of Mr. Clapp's time during the very seasons when (formerly) he did much of the orchard inspection work. (2) The appropriations to this Division for Field Work have not permitted as much of this work as in former years. (3) The readjustment of our work under which Mr. Szymoniak will hereafter do most of the *Spraying Demonstration* work, replaces the orchard inspection work to a certain degree. (4) The other and more imperative lines of inspection work have increased, especially the inspections of imported shipments of plants, and these curtail the possibilities of orchard inspection work. This work is done chiefly by Mr. Clapp, Assistant in Field Work.

5. EXTENSION WORK—ORCHARD SPRAYING DEMONSTRATIONS.

During the year, this work has undergone a change, in the appointment of Mr. B. Szymoniak, who is to conduct work in this project under the Smith-Lever act. This work was formerly done by Mr. Clapp, and, to some extent, by the Entomologist in person.

Mr. Szymoniak is carrying out a schedule of spraying demonstrations in six or more selected orchards. Mr. Clapp has also taken part in several different demonstrations, working with county demonstration agents.

6. REGULATORY WORK—COTTON BOLL-WEEVIL QUARANTINE.

Carried on under State Agricultural Department, by the Entomologist.

7. REGULATORY WORK—INSPECTION OF IMPORTED NURSERY STOCK.

Carried on under State Agricultural Department, mainly by Mr. Clapp, and in part by the Entomologist. Inspection was made of twenty-nine different shipments of imported plants. The following pests were intercepted: European Pear Scale, European Tussock

Moth, Crowngall. In this work we have assistance from two local men who inspect such shipments as come into their respective communities.

8. REGULATORY WORK—NURSERY INSPECTION.

This work is carried on under the State Agricultural Department, and comprises one of the chief duties of the late summer and early fall. The field work is done chiefly by Mr. Clapp, while the correspondence and the issuance of certificates is done by the Entomologist from the office. Over fifty nurseries were inspected and certificates issued.

9. INVESTIGATIVE WORK—LAUNDRY SOAP AS REMEDY FOR APHIDS.

Under this project, which is specified as "merely incidental," no essential new data has been secured during the year though our own experiences, combined with the testimony of correspondents, continues to confirm us in the opinion that a mere solution of laundry soap in water can be relied upon as a remedy for most species of aphids, in place of the more complicated emulsions which are often recommended, or in place of the tobacco preparations, which are not easily obtainable in all localities.

10. INVESTIGATIVE WORK—INSECT LIFE OF NORTH CAROLINA.

The object of the work under this project is to secure as full information as possible concerning the insect life of the State, the species occurring, distribution, economic relations, their biology and ecology, preparation of lists, collection of maps, study of life zones, etc.

This project has been under way since the establishment of this Division in 1900, and a large body of facts, specimens, etc., have been accumulated and placed on record. It can only be brought into final shape through the accumulated efforts of many years. A number of papers bearing on this study have been published in former years in entomological journals, but there have been no publications during the year under review. Minor additions to our collections have been made during the year. This work is carried on intermittently by the Entomologist and the assistants.

11. INVESTIGATIVE WORK—PEACH SPRAYING.

This work is being carried on by the Entomologist and Mr. Clapp on the Iredell Test Farm. A test row of nineteen trees is at our service, and five separate tests are under way, each test including the three trees (two Elberta and one Belle of Georgia), and there is a "check" of four trees (two Elberta and two Belle of Georgia). The plan of work involves the gathering and examination of *all drops* from the time the fruit is "set" until picking. This is the second year of this experiment, and already data has been secured on a considerable portion of the "drop" peaches of the present season.

12. INVESTIGATIVE WORK—POTATO SPRAYING AND FLEA-BEETLE CONTROL.

This work has run through the seasons of 1913 and 1914, and is still in progress. The work of the first two years was done by Mr. C. L. Metcalf, Assistant Entomologist, who resigned in October, 1914. The project is now being carried by his successor, Mr. R. W. Leiby. The plats are on the Buncombe Test Farm. There are some insurmountable obstacles owing to the distance of this farm from headquarters, but we are in hopes that an ultimate analysis of the data accumulated, will be valuable.

13. INVESTIGATIVE WORK—PECAN INSECTS.

This project was begun in 1913 by Assistant C. L. Metcalf, and carried on until his resignation in October, 1914. It is now being carried on by Assistant R. W. Leiby. Their work has thrown much light on the habits and life-history of the already recognized insect pests of the pecan, and facts are already being obtained in regard to other less understood species.

The commercial growing of the pecan is a new industry in this State, and, as most of the investigations of pecan insects have been made in states far to the south of us, where conditions are not altogether similar, this really constitutes an almost virgin field for investigation, and I have good hopes of the results, both biologic and economic, to come from the further prosecution of this line of study. The work is being done at Raleigh and at several eastern localities.

14. INVESTIGATIVE WORK—CORNSTALK BORER.

This project was undertaken in March (1915) by the Entomologist and Assistant R. W. Leiby, and as yet only a beginning has been made. Examination of large numbers of winter stubble ware made to ascertain the degree of infestation in different localities. We attempted to secure test plantings at different dates on the Pender Test Farm, but this was practically nullified by the destructive work of larks, budworms and bill-beetles. Observations have been made on the behavior of the over-wintering larvae in corn-stubble, and the time of their pupation and emergence as adult moths.

In concluding this report I must, as ever before, bear testimony to the good work of my assistants in every duty assigned to them. To them belongs the credit for whatever of success there has been; to me may be assigned the criticism for whatever failures.

The ever-increasing demands of routine and inspection duties, coupled with cramped finances under present conditions, renders it difficult to conduct all lines of work as thoroughly as we might wish. Added to this is the fact that any one of these projects might well occupy the entire time of one or more men; yet we cannot, in the nature of the case, afford to entirely ignore any of them.

Respectfully submitted, FRANKLIN SHERMAN, JR.,
Chief, Division of Entomology.

REPORT OF THE ENTOMOLOGIST.

To the Director:

Most of the time of the Entomologist has been devoted to a study of the Corn Bill-bug and the Gloomy Scale. However, considerable preliminary work has been done upon the Cowpea Weevil with a view of taking up this project actively when the Corn Bill-bug project is finished in the fall.

Corn Bill-bug.—During the past year most of the work on this project has been devoted to checking up the results of previous years. Certain minor points which have not been clear from our previous work have been cleared up, and the whole project is practically complete with the exception of such points as need to be checked up during the summer and fall. Our field results agree in the main with results of previous years. Very early planted corn gives the best results of any field control that we have tried. Very late planted corn, also, yielded fair results, which is slightly at variance with our previous results. Heavy applications of fertilizers, more particularly those containing nitrate of soda, enabled the rows thus treated to outgrow the attacks of the Corn Bill-bug better than untreated rows. In the laboratory we have carried through successfully life history studies on a large number of Corn Bill-bug larvae in order to check up previous work done both by the former Entomologist and the present Entomologist. Complete compilation of these results will give us enough figures to make us reasonably sure of our results. In as far as practical these results have been checked up with the results in the field, and the substantial agreements of these two sets of observations, one made in the field and the other made in the laboratory, have convinced us that the unnatural conditions in the laboratory have not influenced the life habits of this insect.

Gloomy Scale.—On this project practically all of the time during the past year has been devoted to a study of the life history of the scale and a study of the life history of the parasite in order to check up the results of previous years. The unfavorable weather just at the time the young scale were emerging have handicapped our work somewhat for the present season, but the other details of the project are progressing satisfactorily.

Cowpea Weevil.—Considerable preliminary work has been done on this insect to see whether it would make a satisfactory project for determining certain fundamental laws about insect life. This work has been more or less interrupted by other work, but we have compiled extensive figures to show the total mortality of these insects from the egg to the adult stage, and incidentally we have accumulated a large mass of figures on the egg laying and the other habits of the four-spotted cowpea weevil.

Respectfully submitted,

Z. P. Metcalf,
Entomologist.

REPORT OF THE DIVISION OF HORTICULTURE.

The work of the Division of Horticulture has been continued under lines already laid down in previous reports. As the work progressed it has in many cases been broadened in scope and new or subsidiary lines of investigation added.

Pecan Work.—The elementary phases of pecan work have been passed and two bulletins have already been published on the culture and general management of this crop. The orchards on the Eastern Test Farms are increasing annually in production, and the question will soon be open as to the marketing of the crop. Our success with pecans has led us to extend the nut work by adding to our orchards plantings of almonds, filberts, chestnuts, Japanese and English walnuts.

Pecan breeding was begun three years ago by making a number of crosses by hard pollination between the large number of varieties of pecans under test. Five hundred seedlings resulting from these crosses have this year been set out in the form of a test orchard.

Muscadine Grapes.—The muscadine grape vineyard has been extending annually according to plans originally laid down. The various phases of the cultural, pruning, trellising, fertilizer and hybrid testing work now cover eighteen acres of land. Valuable data are being secured each season, but the work will be continued a few years yet before a final summing up of the results is made.

Thermal Work.—The investigations on the phenomena of thermal belts, as noted in previous reports, are being carried on each year. On the fifteen observing stations the temperatures at various points on the orchard slopes have been recorded automatically for every minute of the last four years during which the investigations have been in progress. Remarkable differences in temperature have been recorded on the long slope at Ellijay of 1,740 feet, and relative variations have been noted in the shorter slopes at the other stations. At Ellijay the experts of the National Weather Bureau are conducting an extensive series of tests on aerial radiation. In order to make a careful study of the temperature as affected by the local topography, Mr. Baker, our drainage engineer, is making detailed surveys of each station and preparing accurate contour maps.

Peach Work.—With the addition of an experimental pomologist we have been able to undertake investigational work with peaches. This new work includes:

1. Study of peach bloom and other botanical characters in relation to origin and type.
2. Study of commercial varieties for North Carolina.
3. Cultural methods.
4. Study of hardiness.
5. Breeding commercial varieties.

This work is being carried on in the Test Farm orchards and also in the large commercial orchards throughout the State.

Demonstration Work.—By means of the Smith-Lever funds we have been able to carry to the people, in the form of horticultural demonstrations, the results we have worked out from our experimental tests. Mr. B. Szymoniak has been carrying on this work and has held orchard meetings throughout the fruit region, where he has visited a great many orchards and given instruction in pruning, spraying and general orchard management. He has also been giving many demonstrations of the patch budding of pecans, the method recently worked out and published in Bulletin No. 224. In the autumn Mr. Szymoniak will put in his time judging horticultural products at fairs.

Vegetable Work.—The lines of vegetable testing work under way have been continued and some of them extended in scope. The cantaloupe experiments which have been conducted to show the value of specially selected seed have been sufficiently matured for the publication of a preliminary bulletin on the subject. This publication was by Mr. R. G. Hill and was gotten out as the August Bulletin of Department of Agriculture series.

The Irish potato work in progress has been carried on in the mountains and in the coastal region. Mountain-grown seed is being tested for the production of the early crop in the eastern part of the State. Many methods are also being tried for the production of a second crop in the coastal region. Hill and tuber unit selections are being followed.

The cabbage tests in the mountains are being continued. The work has been extended to include a test of the most practical methods of storing this crop for the late market.

For the last three years experiments have been conducted at the Pender Test Farm in the storage of sweet potatoes. The storage house we have been using, owing to faulty construction, has not given satisfactory results. This house is now in use for other purpose and a new house is being constructed along more approved lines, which will be ready for the crop this fall. In carrying on this work several new factors have been found to have an important bearing on the problem. These have broadened the scope of the work, and at the same time extended the time for the maturity of the experiment and the publication of results.

W. N. Hutt,
Chief, Division of Horticulture.

REPORT OF THE HORTICULTURIST.

To the Director:

I have the honor to submit the following report of the work in Horticulture for the year ending June 30, 1915.

The personnel has remained unchanged, and, as a result, the work has been prosecuted without interruption or delay.

During the year the projects conducted under the provisions of the Adams Act have occupied the greater part of the time. The first of these was

A STUDY OF SELF-STERILITY IN BLACKBERRIES AND DEWBERRIES.

In the report for last year it was stated that the results of this investigation would be published in a short time, but the discovery of one or two sources of probable error made it necessary to postpone the making of a report until after another season had passed. The report is now being written, and will soon be ready for publication.

In this work several interesting and valuable facts have been confirmed and extended, and others have been established. Among varieties of blackberries, of which sixteen have been studied it has been found that three are perfectly self-sterile; one is partially so, and twelve are perfectly self-fertile; and that of the wholly or partial self-sterile varieties all are hybrids between blackberries and dewberries. This apparently confirms the belief in the correlation of hybridity and loss of self-fertility, and furnishes definite information as to the varieties studied. Among the dewberries, on the other hand, three of the fifteen varieties studied are of hybrid origin. Of these, two are perfectly self-fertile, while one is perfectly self-sterile. As a matter of fact, practically all of the perfectly self-stirile varieties of both blackberries and dewberries are derived from *Rubus trivialis* as one parent, while those from *Rubus villosus* are partially or wholly self-fertile. This is in perfect accord with the facts that *Rubus villosus,* from which most of our cultivated dewberries are derived, is self-fertile, and that *Rubus trivialis* is self-sterile in their natural habitats, and indicates the relatively greater purity and sexual strength of the former.

Another and still more interesting fact is that the pollen of self-sterile varieties is not lacking in viability, as was the case with Muscadine grapes, and that when applied to flowers of other self-sterile results in the fertilization of the ovules and the setting of fruit in a normal manner. This fact makes it evident that *unmixed planting* of *varieties* is to be *avoided.*

The cause of self-sterility is evidently to be found in a natural antipathy between pollen and stigma or pistil, but the ultimate cause has not yet been determined. This part of the problem will require more time and greater facilities than are now available. It will be necessary to make a cytological study of pollen and flower organs in all stages of

growth in order to make progress along this line, and at present growing-season difficulties seem to prevent this being done.

The second, and chief, work of interest was

A STUDY OF TRANSMISSION OF CHARACTERS IN HYBRIDS OF MUSCADINE GRAPE

The last published results appeared in Technical Bulletin No. 10, "Breeding Rotundifolia Grapes: A Study in Transmission of Characters," by Reimer and Detjen. During the past year this work has been extended along several of the most promising lines which have developed in the course of investigation, and gives promise of valuable results. Reports so far made have essentially been negative in character. First efforts were necessarily directed toward the discovery of limitations, but in connection with this object certain facts were determined which give promise of positive advance in the work of securing early improvements in varieties of this class of grapes. A bulletin setting forth these facts is now in preparation.

In addition, during the year just ended, a statistical study of the data already obtained in connection with the analytical work has been. This will strengthen and put into concrete form the findings already made and form the basis of more accurate determinations in the future.

Other investigations in which the Division is interested are "A Study of the Effect of Plant Food on Pollen" and of "Seedlessness in Persimmons." The first of these may possibly have a more or less direct bearing upon the work in connection with the blackberries and dewberries, but because of lack of greenhouse facilities has been temporarily suspended. The second project in this class has been started, but it has not yet been possible to make permanent headway, because of lack of a sufficiently large and secure area. It is hoped that the urgent need of these facilities will soon be met.

In closing this report, the Horticulturist wishes to express his appreciation of the cordial help and support which he has received at your hands,

Respectfully,

J. P. Pillsbury,
Horticulturist.

REPORT OF THE DIVISION OF ANIMAL INDUSTRY.

To the Director:

The following statements give a brief summary of the investigational work conducted by the Animal Industry Division for the fiscal year 1915.

SWINE.

1. To determine the toxic principle in cottonseed meal.

This work has been under way for a number of years and is done in cooperation with the Divisions of Chemistry and Veterinary Medicine. During the winter of 1913-'14 36 pigs were used in the investigation.

2. To determine the value of temporary pasture crops for fattening hogs.

This work is being done upon the Central Farm at Raleigh, at the Pender Farm and at the Edgecombe Farm. During the past winter most of the work has been done with rape, rye, soy beans and peanuts.

3. To determine the value of waste peanuts as a feed for hogs.

This work is being done upon the Edgecombe Test Farm and in cooperation with Messrs. Holderness and Shook, at Tarboro.

4. To determine the effect of peanuts, soy beans, mast and other softening feeds upon the bodies of hogs and their lards, with a view to developing a plan of feeding to counteract these unfavorable results.

Samples of lard have been taken from about 300 animals. The Chemist, Mr. Dan. M. McCarty, was added to the force of the Animal Industry Division in June and he is now devoting all of his time to this problem.

5. To determine the expense of raising pigs to the weaning age in the Coastal and Piedmont sections of North Carolina.

This work is being done on the Pender and Iredell Test Farms.

6. To study the best and most economical methods of curing meats on the farm.

BEEF CATTLE.

1. To determine the relative value of various quantities of cottonseed meal for fattening steers in connection with cottonseed hulls and corn silage, and to note the effect of these feeds upon the quality of the meat.

During the winter of 1913-'14 128 steers were used in this test.

2. To make a direct comparison of the relative value of cottonseed hulls and corn silage when fed in conjunction with cottonseed meal, and to determine the effect of each combination of feed upon the quality of the meat.

3. To determine the value of shelter in feeding fattening cattle on the sandy soils of North Carolina.

This work was done at the Pender Test Farm, thirty steers being used.

4. Coöperative beef cattle work with the Bureau of Animal Industry at Washington, conducted on the farm of T. L. Gwyn, of Haywood County.

These experiments were inaugurated November 1, 1913. The following problems are being studied:

(a) To determine the profit, if any, in introducing corn in a ration of cottonseed meal.

(b) To determine the best and most economical method of wintering stockers when they are to be finished the following summer on pasture.

(c) To determine the feasibility and practicability of fattening cattle in the summer on pasture when the pasture is supplemented with cottonseed cake.

SHEEP.

At the present time investigational work with sheep is being conducted on the Central Farm, Edgecombe Farm and Iredell Farm. The following studies are being made:

1. To determine the cost of maintaining a flock of sheep under various conditions.

2. To determine the cost and feasibility of producing early lambs for the April, May, and June markets.

3. To determine the effect of cottonseed meal, when fed in various quantities, upon the health, condition and reproductive system of the animals.

4. To determine the value of the use of Merino, Shropshire and Barbadoes rams in grading up native ewes and in crossing upon each other.

5. To determine whether the Barbadoes sheep are in any degree resistant to the attack of the stomach worm.

6. To determine the best method of wintering breeding ewes.

DAIRY INVESTIGATIONAL WORK.

Most of the investigational work along dairy lines is being done at the Pender Test Farm. The cheese work and the experiment which has to do with feeding young calves cottonseed meal is being carried on at the Central Test Farm at Raleigh. The following studies are being made:

1. To determine the cost of raising dairy calves in the South.

2. To determine the exact value of silage when compared with southern dry feeds and with winter and spring pastures.

3. To determine the value of various winter feeds for wintering dairy calves, special emphasis being given to cottonseed meal and the possibility of removing the danger of cottonseed meal to young calves.

4. To determine the best and most satisfactory method of making skim milk, buttermilk and cottage cheese.

5. To determine the possibility of eliminating onion flavor from milk and butter.

POULTRY.

The poultry investigational work is being done at the Central Test Farm at Raleigh and at the Iredell, Edgecombe, and Pender Test Farms. The following problems are being investigated:

1. To determine the profits, if any, in keeping farm flocks of hens under ordinary farm conditions.

This includes a study of the various green-growing winter crops for feeding laying hens.

2. To determine the effect upon the general health and reproductive systems of the fowls when kept under dry lot conditions as compared with pasture conditions.

3. To determine the effect of various amounts of cottonseed meal upon flocks of chickens.

4. To determine the possibility of fixing the character of high egg production and at the same time maintain the weight and vigor of the fowls.

5. To determine the best method of finishing fowls for market in the South.

6. To determine the extent of the infection of animal parasites from the standpoint of the whole State and their means of control.

7. An extensive study of the cause of chick mortality is being made in the laboratories.

8. A study is being made of the comparative anatomy of the chicken and other fowls.

HORSES AND MULES.

Only one problem is being studied with horses and mules. This is being carried forward at the Edgecombe, Iredell, and Pender Test Farms. This study is to determine the place of cotton-seed meal in a ration for work horses and mules.

Very respectfully submitted,

DAN T. GRAY,
Chief, Animal Industry Division.

DIVISION OF VETERINARY SCIENCE.

To the Director:

I beg to submit the following report of the Veterinary Division for the fiscal year ending June 30, 1915.

For a number of years we have noted a rather large number of abortions and sterilities among domestic animals and also retained afterbirths in cows, that lead us to believe that possibly there is a common cause in each class of animal for all of these troubles.

Investigations from history, observations and laboratory tests indicate that the so-called "contagious abortion" of cattle exists quite generally over the State.

As has been stated by some authorities and intimated by others, we are likewise of the opinion that the name contagious abortion is very inappropriate for naming the disease, since the abortion is only one of the symptoms, and often not the most serious.

We are inclined to believe that this trouble, with others, belongs to a venereal infection. It is probable, however, that the infection may be introduced into the system through other means than sexual intercourse, but is only capable of producing its disease symptoms when invading the genital organs.

While this infection is very general, perhaps the most widely spread infection known, fortunately in most cases it is quiescent and not showing marked symptoms of its presence. Under proper environment, however, we believe it is responsible for all of the granular vaginitis (of vulva), practically all abortions, assisted occasionally by other causes, including premature births, stillbirths and birth of weaklings, all retained afterbirths and inflammations of the uterus following calving and a very large per cent of temporary and permanent sterilities—the occasion for more than one service.

So extensive is the trouble that we have found no herd in any section of the State, and few private cows, free from the granular vaginitis. Many owners report more or less abortions, a greater number of retained afterbirths and a great deal of trouble in getting their cows to catch.

These findings, however, are no exception to the general rule, for in those states where investigations have been made conditions are similar.

If all of these troubles and their attendant losses are charged up to a single cause the toll will be very heavy and few single diseases will approach anywhere near it.

The sterility factor seems to be the most serious phase of the problem with many. From examination of live animals and observations at abattoir we find the ovaries, the uterus and the vagina often perceptably altered.

The affections of the ovaries consist of an inflammation and indurated enlargement, a persistent *corpus luteum* (yellow body) and a cystic condition.

This latter condition has been observed in many cows and mares known to be barren and which are often constantly in heat (nymphomaniacs).

The *corpus luteum* apparently has the function of inhibiting ovulation (egg production); hence in a diseased ovary this body often fails to be absorbed and finally undergoes a cystic degeneration.

If these conditions can be sufficiently modified through massaging of the ovary the sterility should be overcome.

A number of cases of purulent inflammation of the uterus have been observed.

We cannot believe that many of the barren cows are due to a "closed" uterus, or if such, that it can be often overcome. The neck of the uterus of the cow is peculiar in that it is four to six inches long, more or less tortuous, partially obstructed by mucous folds, and naturally has a very small channel through it. Out of several hundred examinations of nonpregnant uteri there were only two or three that would not admit the size of the meat skewer and few that would admit of anything much larger.

The vulva in nearly all cows and most unbred heifers over three months of age showed a mild or an aggravated case of "granular vaginitis," a number of which presented a purulent inflammation of the vagina. We believe it possible that this condition is detrimental to the spermatozoa of the male and that by frequent irrigations of the vagina with a mild antiseptic solution the sterility may often be overcome.

The control for the present of all the symptoms of this venereal trouble, we believe, will be accomplished by keeping the infection dormant by good hygienic and sanitary measures, by massaging the ovaries per rectum when diseased, by irrigating with mild antiseptics the vagina of cows, and likewise the sheath of the bull before and after service.

Carbolic acid and methylene blue have been widely advocated for the control of infectious abortions in cattle, both of them administered by the mouth, and the former hyperdermically also. Our experience and observations do not warrant such advice. The course of this infection in nearly all herds is very erratic, and our check animals without such treatment have responded as effectually as the treated. Again, from an anatomical and a physiological point of view it would seem impossible for these agents to be effective. We are supported in this view by a number of other investigators.

Numerous inquiries concerning abortions and sterilities in mares indicate that a similar venereal disease is quite prevalent among horses also. Each year seems to have more breeding troubles than the previous one with other classes of animals as well, and we are wondering if all classes of animals likewise have their specific venereal diseases.

We have had occasion a number of times to employ, and to observe others use, one of the newer methods of applying the tubercular test (intradermal) and find it very satisfactory. Especially applicable is it

for a retest on the herd or as a check test on the older (thermal) method when giving a suspicious reaction.

A number of pathological tissues have been sent in for microscopical examination, as well as a number of animal parasites which have been received for indentification.

Autopsies during the past year were conducted upon the following experimental animals:

One calf dead from cottonseed meal in its ration; 16 swine dead from effects of cottonseed meal with and without iron and ashes as antidotes.

The antidotes did not appear to be as efficient as in previous tests, we believe due to hogs being housed and kept on floors, preventing them from ingesting other mineral matter from the soil, which apparently has a neutralizing effect upon toxic properties of the meal.

Fifteen rabbits dead from feeding on the intraperitoneal injections of gossypol (coloring matter of cotton-seed meal).

Four Barbadoes sheep dead from various causes. All harbored a few specimens of stomach worms (*Hæmonchus contortus*), and the small and large intestines showed a number of parasitic nodules.

By request we have served as judge of horses and cattle at the Mecklenburg and Union county fairs, and have taken part in live stock meetings at Statesville and Newells.

A number of minor diseases have been looked after among the Station animals, mostly in the form of wounds and lamenesses.

One animal had to be destroyed because of sever incurable lameness in all four feet, due to bony growths (ring bones and side bones).

The usual amount of correspondence concerning feeding, breeding, and diseases of live stock has been conducted as in former years.

G. A. Roberts,
Veterinarian.

REPORT OF DIVISION OF PLANT PATHOLOGY AND BACTERIOLOGY.

To the Director:

I submit the following report on the work of this department for the fiscal year ending June 30, 1915.

Soil Bacteriology (Adams Fund, in coöperation with the Department of Chemistry).—Work has been mainly in the direction of working out a new method for studying more closely than is now possible nitrification activities, both of specific soil organisms and of the bacterial flora of particular soils.

Life History Studies of Bacterium Solanacearum (Adams Fund).—A new host plant has been found presumably, in the common ragweed. Field and laboratory work to completely prove this has been carried forward.

Apple Root Rots (Adams Fund).—Isolation of four organisms, suspected of causing as many distinct types of root rot, have been made, and inoculations to test their pathogenicity are in progress. Their life habits are being studied in the field and laboratory.

Peanut Diseases (Adams Fund).—This project has been undertaken during the year. Attention is being given mainly to the stem and root rot diseases caused by *Sclerotium rolfsii* and by a *Rhizoctonia* species.

Tobacco Bacterial Wilt (Hatch Fund, in coöperation with the U. S. Department of Agriculture).—The testing of definite crop rotations and of certain soil treatments, and the breeding for resistance have been continued at Creedmoor. This project has been extended to include control of the same disease of tomato, with especial reference to discovering a resistant canning type of tomato.

Watermelon Wilt Control (Hatch Fund).—This has included further work in improving the rind characters of the North Carolina wilt resistant melon. Small trial lots of seed have been distributed again to growers in various parts of the State, and their reports have been encouraging.

Cotton Diseases (Hatch Fund).—The testing of certain standard varieties of cotton for resistance to anthracnose has been continued, in coöperation with plant pathologists in several other states. Seed of all promising varieties of wilt-resistent cotton have been planted in cooperation with farmers on wilt-infested land in Edgecombe and Columbus counties, to determine which of these varieties may be best for use under Eastern North Carolina conditions in the control of the wilt.

Lettuce Drop (Adams Fund).—Studies have been made of the cultural characters and pathogenic tendencies of the organism in comparison with the species of *Sclerotinia* attacking clovers and alfalfa, with a view to determining the possible identity of these. Studies are being made on modes of dissemination and persistence in the soil.

During the year this Department has coöperated with the North Carolina Department of Agriculture and the United States Department of Agriculture in eradicating the chestnut bark disease where it had appeared in Guilford County, and in watching shipments of northern-grown seed Irish potatoes to guard against the introduction of powdery scab or other serious diseases.

The Plant Disease Survey has been continued along the usual lines in coöperation with the United States Department of Agriculture. There have been the usual inquiries by citizens of the State about some hundred and twenty-five diseases affecting a wide range of crop plants.

There was no change in the personnel of the staff during the year.

Respectfully, H. R. Fulton.

REPORT OF THE DIVISION OF MARKETS AND RURAL CO-OPERATION.

To the Director:

I submit the following report of the work of the Division of Markets and Rural Coöperation for the year 1914-1915.

MARKET QUOTATIONS.

The Weekly Price Report, which was begun to give quotations on cotton, cotton seed, and meal, has been extended to include prices of corn, oats, cowpeas, soybeans, Irish and sweet potatoes, apples, canned goods, butter, eggs, and poultry. It has come to be widely published by the newspapers of the State. According to letters received from both merchants and farmers it is accomplishing its purpose to show where to buy and sell.

So far all price reporting has been done *gratis* by merchants, chambers of commerce, and demonstration agents. If we paid for having it done in the case of merchants it would enable us to better hold them in line. This would involve an additional appropriation of three to four hundred dollars. All markets quoted should be regularly visited to determine the accuracy of all reports and to keep in touch with the demand for farm products.

LISTING SELLERS, BUYERS, AND RECEIVERS OF FARM PRODUCTS.

One of the main assets of a private business is to establish connections with responsible parties in all markets where advantageous sales or purchases may be made. In the case of the large number of farmers whose products we list for sale we cannot hope to have sufficient acquaintance with the quality of goods they ship to be able to guarantee them. The individual merchant can usually protect himself by making no payment until he has received his goods and satisfied himself as to their grade. This necessarily puts the farmer in the hands of the buyer or receiver to determine the grade of his goods and their condition upon arrival. For disorganized farmers the best we can do is to exercise care in the selection for them of responsible parties to handle their products. We should have on our lists the name of at least one responsible agent and specialist for all products in all markets in which we may advantageously sell. So far we have largely relied upon credit-rating books to judge of the responsibility of commission houses, jobbers, and retailers. But a personal canvass of all markets would give us a better knowledge of the responsibility of agents and merchants and at the same time enable us to push the sale of our goods.

ORGANIZATION.

In so far as farmers are organized to systematically grade their products, we are in a better position to speak in behalf of their goods and to push their sale in different markets. This office has been engaged this last year in developing organizations for grading and marketing

potatoes, corn, soybeans, and strawberries. For an organization to standardize its pack enables it to guarantee its grade and maintain its product upon a market in competition with that of other communities.

Many reports received in our canvass of the trade show that North Carolina sweet potatoes and strawberries have come to be handled only as "fillers" because of an inferiority of their pack. As soon as Virginia sweet potatoes or strawberries have come in dealers have frequently dropped the North Carolina products and the market generally has shown a preference for those of Virginia. Our season for marketing these products may be lengthened through organization to standardize their pack and to make their grade as good or better than that of our competitors.

Through the system of inspection maintained by the Carolina Potato Exchange this last year Carolina sweet potatoes did not drop in price as usual at the entrance of sweet potatoes from the Eastern Shore of Virginia Produce Exchange. For the first time in the history of the sweet potato industry Carolina sweet potatoes were quoted higher than those of Virginia this last season on the New York market. A lengthened season means larger potatoes may be dug and better quality and prices insured generally.*

The Carolina Potato Exchange would not have been formed this year unless we had agreed to help finance it. We paid the salary of the manager and of the assistant manager, who also acted as general inspector. In order that we may be sure of maintaining the uniformity of the grade of this organization we should continue to furnish a general inspector.

It seems that the initial financing of farmers' organizations to demonstrate their value bears the same relation to marketing as test farms and demonstration agents to production. The initial cost is sometimes too great, and confidence is frequently too slight, for farmers to take up the work of organization unless financial help is extended to others in the form of a manager or inspector being loaned to them during the uncertain stages of development. But help of this kind should not be extended where it can be avoided, and then should be withdrawn as soon as the volume of business transacted makes the organization self-supporting. No organization should be started which cannot very soon develop sufficient business to cover all expenses. However, generally a small organization cannot afford the expense of investigating markets and developing new territory in order to widen present markets. This work, which the small business cannot do, should be the function of a State Division of Markets. An efficient service for keeping in touch with markets for any given product or products will answer the purpose of a hundred organizations as well as one, provided enough assistants are employed by the Division of Markets to see that the different organizations make a proper use of its service.

*For more detailed statement see October Market Bulletin.

Farmers generally are so unacquainted with the problems of a proper system of inspection and distribution of their products that the cost of helping their organizations operate is going to be much greater the first five years. The educational work to get farmers to organize or to maintain them in successful operation must be more intimate and thorough in the infancy of this work.

The marketing organizations formed in this State before the establishment of the Division of Markets have mostly failed. Part of our work has been to cash in this experience for the profit of the new organizations.

THE ORGANIZATION OF THE STRAWBERRY INDUSTRY.

The purchase of the strawberries of the Chadbourn district has gradually fallen into the hands of a few brokers. According to common impression the price has been depressed. Better methods of packing have not necessarily brought better prices. A premium has thus been put upon poor packing. The trade has come to prefer the berries of our competitors. Our strawberries have frequently become mere "fillers" between the Florida and Virginia seasons. A shortened season of marketing has cut down the profits of the crop. These are some of the reasons why the North Carolina strawberry industry has fallen from first to sixth rank in carload shipments.

Northern dealers, as well as our farmers, are agreed that organization would improve the pack and price. Thus far two strawberry associations have been organized at Chadbourn and Tabor. The members of these associations are planning to incorporate the Carolina Produce Exchange, which shall be the general distributing agency. It has finally seemed best not to extend the organization to Rose Hill and Mount Olive, as it will be cheaper and easier to let successful operation of the Exchange in the Chadbourn section spread to other districts than to attempt to bring in distant sections at once. The volume of business of the two associations should be sufficient at the beginning to pay for a general manager. We are planning to pay for one or more inspectors to organize a system of inspection. Later, after the value of this system has been demonstrated and the volume of business has been increased, the organization should be able to pay for its own inspectors and only look to us to keep it in touch with the market demand. The two organizations already formed have agreed our rules for picking, grading, packing, hauling, and inspecting.

The by-laws for the Carolina Potato Exchange and for the Carolina Produce Exchange have been worked out and are ready for distribution to others who are interested in forming like organizations.

OTHER ORGANIZATIONS.

In Hyde County remoteness from railroads makes organization for marketing farm crops very imperative. The dependence upon local markets of this county alone has meant the loss of thousands of dollars in the sale of their corn and soybeans. (See July Market Bulletin).

In the canvass which has been made of the seed houses of the United States we have received very positive assurance of their coöperation with the Hyde County Grain Growers' Association, which has been formed at Swan Quarter.

Organizations are being developed in Pamlico County for marketing late sweet potatoes and corn, and in Beaufort County for corn, soybeans, potatoes, and poultry.

It is very important that no impression should go abroad that the Division of Markets aims to promote organizations promiscuously. Promotion of organizations generally without providing facilities for cooperating with their proper operation would doom many of them to failure.

GRADING COTTON.

Four grading offices have been organized at Tarboro, Wilson, Goldsboro, and Charlotte to grade cotton for Edgecombe, Nash, Wilson, Wayne, Mecklenburg, and Iredell counties. The plan worked out last year in Edgecombe has been followed this year. We have employed four graders who are paid from the Smith-Lever Fund. All cotton is graded under supervision of a representative from the Office of Markets, United States Department of Agriculture.

This year has proven so far very unfavorable for starting cotton marketing organizations. With the sudden great rise in prices farmers have been satisfied to sell for what they could individually obtain. The plans for promoting cotton marketing organizations have not been fulfilled this year anywhere in the South as expected. When farmers are holding cotton there is time to look up the best market. As soon as a marketing association has established a reputation for its grade and financial responsibility it may hope to hold its own in the more difficult time of rapid sales and good prices.

In connection with the work of grading and stapling cotton we have carried on an investigation to determine how far the cotton grown in the State meets the needs of North Carolina mills. A great field of endeavor lies in the direction of standardizing the production so our farmers and mills may have the geographical advantage of a raw product produced in proximity to the mills. Through organization a system may be introduced to produce and market what the mills need. At present the failure to recognize staple and grade in the price paid puts a premium on careless methods in the selection of variety grown and in harvesting cotton. The gross return to the community is thereby decreased. The loss through the failure of local buyers to buy on grade amounts to unknown thousands of dollars as applied to eggs, potatoes, corn, fruit, and cotton.

RURAL CREDIT.

Notwithstanding the campaign of education which the Division of Markets has carried on to educate farmers to the use of the Credit Union as provided for by the last Legislature, this office has received only

two inquiries from business men and one from a farmer in reference to Credit Unions. As we are given additional help to look after the promotion of marketing organizations we shall go to the farmers to bring home to them the advantages of organization to raise their credit rating in the community.

The work of promoting organization for better credit is now being carried on in coöperation with the Demonstration Agents. As soon as some initial interest is shown in different communities meetings will be held to carry forward the interest.

Our investigations of credit conditions show that our limited or high price credit is a serious hindrance to the development of agriculture. Demonstration agents as well as bankers have reported a cost of credit which makes the adoption of improvements very difficult and, to a large extent, impossible.

We have not published a bulletin on credit though we have abundant material of an investigational character. We do not wish to seem to recommend an untried remedy which might not fit our needs. As soon as the North Carolina Law has been tried and found capable of adaptation to our situation we shall substitute the bulletin for the circular form of statement.

ORGANIZATION OF THE APPLE INDUSTRY.

Two associations for marketing apples, one at Waynesville and the other at North Wilkesboro, were organized before the Division of Markets was started. They failed because of ignorance of markets and of expenses greater than the volume of business would bear. Their failure to meet the needs of the situation has made the forming of any new organizations very difficult.

Through present methods of spraying, packing, and selling apples in bulk the apple growers of the State lose in the neighborhood of a half million dollars in a good crop year. (See Market Bulletin No. 12.)

To meet the needs of the apple industry the Division of Markets has offered to pay a manager's salary and traveling expenses for an organization to be known as the Carolina Apple Exchange, provided it would hire all necessary inspectors to look after grading and packing, stand for necessary office expenses, and pay the manager's salary thereafter. The plan is to organize locals wherever the volume of business will support the expenses for inspection and to market all apples through a central distributing agency.

DEVELOPING A MARKET FOR ANIMAL PRODUCTS.

We are receiving calls for assistance to help in the marketing of butter, eggs, poultry, and pork. Our survey of the Southern market for butter and eggs has shown a market at our door, but yet to be reached. Our rapid increase in the manufacture of creamery butter is making a market problem which is every year becoming more acute. It is the opinion of the Animal Husbandry Division as well as that of this office

that production is being arrested by lack of assurance of sufficient markets.

In the case of eggs our investigations have shown a great difference of prices which does not exist in a state of well developed markets. Our Weekly Price Report should help in informing farmers and merchants of prices in standard markets. But it seems instruction in proper methods of egg and poultry production would best be made effective by the encouragement of good prices. The principle runs here as elsewhere: Dependence upon one market, whether the buyer be a local merchant or a traveling buyer, constitutes that market a monopoly which will depress prices.

We believe, along with the Animal Husbandry Division, that a market for animal products may best be developed through the employment of a specialist to push their sale. Such a specialist should have had training in the sale of such produce.

Organization of the sale of canned goods.

This Division has also worked in coöperation with that of Home Demonstration work to develop better business methods and organization in the marketing of canned goods. With an estimated output of 600,000 cans it is hoped that the problem this year is solved with present means. But increase of production undoubtedly already awaits the development of markets. Organization to market the surplus products of different counties may need some help in financing its initial stages in the near future.

Respectfully submitted,

Wm. R. Camp,

Chief, Division of Markets and Rural Coöperation.

FINANCIAL REPORT.

THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

in account with

THE UNITED STATES APPROPRIATIONS, 1914-1915.

DR.	*Hatch Fund.*	*Adams Fund.*
To receipts from the Treasurer of the United States, as per appropriations for the fiscal year ended June 30, 1915, under acts of Congress approved March 2, 1887 (Hatch Fund), and March 16, 1906 (Adams Fund)	$15,000.00	$15,000.00
CR.		
Salaries	$8,050.55	$13,230.00
Labor	2,664.50	655.02
Publications	.....	.....
Postage and Stationery	365.84	104.76
Freight and Express	435.29	46.94
Heat, Light, Water and Power	109.70	72.00
Chemicals and Laboratory Supplies	.....	211.82
Seeds, Plants, and Sundry Supplies	327.90	80.31
Fertilizers	302.48	31.05
Feedings Stuffs	1,615.39	17.68
Library	.....	.....
Tools, Machinery and Appliances	365.93	.....
Furniture and Fixtures	41.70	26.00
Scientific Apparatus and Specimens	.....	447.39
Live Stock	.....	50.85
Traveling Expenses	146.44	26.18
Contingent Expenses	20.00	.....
Buildings and Land	554.28	.....
Total	$15,000.00	$15,000.00

THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

in account with

Farm and Miscellaneous Receipts.

Dr.

Balance in Bank June 30, 1914	$1,606.33
Receipts from other sources than the United States for the year ending June 30, 1914	9,721.59
Borrowed from Bank	4,666.76
	$15,994.68
Overdraft June 30, 1915	1,503.56
	$17,498.24

Supplemental Statement.

Cr.

Labor	$690.54	
Publications	217.55	
Postage and Stationery	84.16	
Freight and Express	71.29	
Heat, Light, Water, etc	82.95	
Chemical Supplies	38.51	
Seeds, Plants, and Sundry Supplies	221.86	
Fertilizers	1,173.31	
Feeding Stuffs	2,056.90	
Library	188.90	
Tools, Implements and Machinery	549.51	
Scientific Apparatus	745.89	
Live Stock	6,225.73	
Traveling Expenses	80.12	
Contingent Expenses	4,705.25	
Buildings and Repairs	365.77	
		$17,498.24

We, the undersigned, duly appointed auditors of the corporation, do hereby certify that we have examined the books and accounts of the North Carolina Experiment Station for the fiscal year ending June 30, 1915; that we have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $30,000, and the corresponding disbursements $30,000; for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving nothing.

And we further certify that the expenditures have been solely for the purposes set forth in the Acts of Congress, approved March 2, 1887, and March 16, 1906.

(Signed) W. E. Daniel,
O. Max Gardner,
Pascal S. Boyd,
Auditors.

(Seal)
Attest: A. F. Bowen,
Custodian.

BULLETIN 228 AUGUST, 1914

NORTH CAROLINA

AGRICULTURAL EXPERIMENT STATION

CONDUCTED JOINTLY BY THE

STATE DEPARTMENT OF AGRICULTURE

AND THE

COLLEGE OF AGRICULTURE AND MECHANIC ARTS

RALEIGH AND WEST RALEIGH

AIR-COOLED APPLE STORAGE HOUSES

THE NORTH CAROLINA
AGRICULTURAL EXPERIMENT STATION

CONDUCTED JOINTLY BY THE

STATE DEPARTMENT OF AGRICULTURE

AND THE

N. C. COLLEGE OF AGRICULTURE AND MECHANIC ARTS

BOARD OF AGRICULTURE

*W. A. Graham, *Chairman*, Raleigh.

F. P. Latham---Belhaven	*A. T. McCallum---Red Springs
K. W. Barnes---Lucama	*C. C. Wright---Hunting Creek
*R. L. Woodard---Pamlico	William Bledsoe---Gale
Clarence Poe---Raleigh	W. J. Shuford---Hickory
*R. W. Scott---Haw River	A. Cannon---Horse Shoe

BOARD OF TRUSTEES OF THE COLLEGE

Governor Locke Craig, *Chairman.*

M. B. Stickley---Concord	*T. T. Thorne---Rocky Mount
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†N. B. Broughton---Raleigh	T. E. Vann---Como
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Everett Thompson---Elizabeth City	W. E. Daniel---Weldon
R. H. Ricks---Rocky Mount	*W. H. Ragan---High Point
O. Max Gardner---Shelby	W. B. Cooper---Wilmington
M. L. Reed---Biltmore	J. P. McRae---Laurinburg

*D. H. Hill (President College), West Raleigh.

STATION STAFF

B. W. Kilgore---Director	C. L. Metcalf---Assistant Entomologist
C. B. Williams---Vice Director, Agronomist	A. R. Russell---Assistant in Field Experiments
W. A. Withers---Chemist	R. Y. Winters---Agronomist in Crops
Franklin Sherman, Jr.---Entomologist	W. F. Pate---Agronomist—Soils
W. N. Hutt---Horticulturist	E. C. Blair---Assistant Agronomist—Soils
G. A. Roberts---Veterinarian	[3]C. B. Ross---Poultry Clubs
[1]C. R. Hudson---Farm Demonstration	E. S. Dewar---Assistant Chemist
J. P. Pillsbury---Horticulturist	R. G. Hill---Assistant Horticulturist
H. R. Fulton---Plant Diseases	[4]H. M. Lynde---Drainage Engineer
Z. P. Metcalf---Entomologist	[1]J. M. Johnson---Farm Management
Dan T. Gray---Animal Industry	F. R. Baker---Assistant Drainage Engineer
T. H. Taylor---Acting Poultryman	A. L. Field---Assistant Chemist
W. R. Camp---Marketing	R. O. Cromwell---Assistant, Plant Diseases
J. M. Pickel---Feed Chemist	[3]A. J. Reed---Dairy Farming
W. G. Haywood---Fertilizer Chemist	Stanley Combes---Assistant, Dairy Farming
L. L. Brinkley---Soil Survey	A. L. Shook---Assistant, Beef and Swine
S. B. Shaw---Assistant Horticulturist	W. C. Norton---Assistant in Bacteriology
[2]W. E. Hearn---Soils	[1]T. E. Browne---Assistant in Charge Boys' Clubs
R. S. Curtis---Associate in Animal Industry	A. K. Robertson---Assistant in Boys' Clubs
J. L. Burgess---Agronomist in Crops	[1]Mrs. C. McKimmon---Asst. in Charge Girls' Clubs
J. K. Plummer---Soil Chemist	[1]Miss Margaret Scott---Assistant in Girls' Clubs
S. C. Clapp---Assistant Entomologist	R. C. Jurney---Soil Survey
W. H. Eaton---Dairy Experimenter	E. B. Hart---Assistant Chemist
G. M. Garren---Assistant Agronomist in Crops	F. E. Carruth---Assistant Chemist
[1]E. H. Mathewson---Tobacco Expert	J. R. Mullen---Assistant Chemist
S. O. Perkins---Soil Survey	Miss Mary S. Birdsong---Secretary to Director
J. Q. Jackson---Assistant Chemist	A. F. Bowen---Bursar
L. R. Detjen---Assistant Horticulturist	

R. W. Collett---Assistant Director Branch Stations
F. T. Meacham---Assistant Director Iredell Branch Station, Statesville
J. H. Jefferies---Assistant Director Pender Branch Station, Willard
F. N. McDowell---Assistant Director Edgecombe Branch Station, Rocky Mount
[1]E. G. Moss---Assistant Director Granville Branch Station, Oxford
F. S. Puckett---Assistant Director Buncombe and Transylvania Branch Stations, Swannanoa

The members marked with * are members of the Joint Committee for Agricultural Work, and the Station is under their direction.

[1]In coöperation with the U. S. Department of Agriculture, Bureau of Plant Industry.
[2]In coöperation with the U. S. Department of Agriculture, Bureau of Soils.
[3]In coöperation with the U. S. Department of Agriculture, Bureau of Animal Industry.
[4]In coöperation with the U. S. Department of Agriculture, Office of Experiment Stations.

†Deceased.

AIR-COOLED APPLE STORAGE HOUSES.

By W. N. HUTT.

As soon as apple growing has reached commercial proportions the demand for some kind of storage becomes imperative. Even with most favorable markets, it is seldom at harvest-time that fruit can be sold to advantage. At that time of year there is generally such a large amount of early fruit that must find an immediate market that the highest grade fruit, and especially long-keeping sorts, are sacrificed if they have to be sold at picking time. Furthermore, there is always a greater or less proportion of cull or defective fruit as the result of sorting and grading that gluts the market at harvest-time and depresses the demand for better fruit. Very often, a month or two later, when the harvest glut is over, there is a shortage of fruit, with attendant high prices. In the oldest and best developed commercial fruit regions the utilization of modern methods of cold storage has been the means of saving to the growers immense amounts of fruit that would otherwise have been lost or sacrificed on an overstocked market. In this way cold storage has had an important influence in encouraging the development of commercial fruit culture and in establishing it as a stable industry.

If the ideal storage were available it would certainly be one or other of the methods of mechanical refrigeration which modern engineering skill has of late brought to such a high degree of perfection. Owing, however, to the high cost of construction and installation of such plants, and the fact that to pay they must be operated the year round, they are practically beyond the reach of the average farmer and fruit grower. Even ice-cooled storage houses are usually impracticable except where handled by coöperative organizations or fruit exchanges.

Several times in the last few years my attention has been called to remarkably fine fruit being put on the market late in the season by mountain farmers. These apples had been kept in various kinds of cellars and caves, and were almost as sound and firm as the fruit coming from cold storage. One old man used to come over from the Blue Ridge Mountains bringing with him, on the same load, apples of this and of last season's crop. This led me to investigate the subject of cellar or common storage, with the idea of designing a cheap apple-storage house that would enable our mountain growers to hold over their good fruit until it could find a profitable market. In the meantime some of our most progressive growers had already constructed different forms of air-cooled storage houses and had used them for one or two seasons. Observations were made on these houses, and the two first constructed were equipped with self-recording hygro-thermographs, so as to keep a com-

plete record of temperature and moisture changes within the house during the entire storage period. It was owing to the high cost of these delicate instruments that it was not possible to keep records on all the houses under observation.

The storage house which is practicable for the average fruit grower must necessarily be some form of air-cooled house of sufficiently inexpensive construction that he can afford to use it for storage only during the winter months. Such a house may be placed in the orchard or at some convenient point where it can serve also as packing house and storage for boxes and barrels.

An air-cooled storage, since it depends for its efficiency on the use of cold air, can be operated advantageously only in latitudes where outside winter temperatures are fairly cold and constant. It stands to reason that they would not work in the mild winter climate of the far south. They have, however, proved themselves very efficient in the northern States and in Canada. In the apple regions of our southern mountains, where the high altitude gives a climate similar to that of the northern States, they have also given good results.

MATERIALS FOR STORAGE-HOUSE CONSTRUCTION.

The efficiency of any form of fruit storage house depends on the insulating of a chamber with walls of such materials and of sufficient thickness so that the temperature within will be affected as little as possible by fluctuations of temperature without. Wood is a good nonconductor of heat and makes an excellent material for the construction of storage houses, except for its lack of durability. Stone is not nearly such a good nonconductor as wood, but as it makes a practically indestructible building, it is a material frequently used in the construction of fruit storage houses. On many orchards the rocks that impede cultivation and break up farm machinery find a very useful and convenient place in the construction of an orchard storage house. Brick is a better insulating material than stone, and where obtainable at reasonable prices makes one of the very best and most convenient materials for this purpose. Cement concrete, now so much used for every sort of permanent building, is probably the most common, if not the best, material for the construction of storage houses. Cement construction has the advantage that it makes a dry wall that does not harbor moisture. All sorts of waste and useless stone can be worked in, and yet when completed all surfaces may be smooth and clean. Cement structures may be easily, quickly, and perfectly built by cheap and unskilled labor.

The foregoing discussion of structural materials for storage houses has not mentioned the two best and cheapest insulating substances, viz., earth and air. Ever since the days of the "dugout" it has been known that soil is very slowly affected by changes of heat and cold, and is therefore one of the best materials for insulating against widely fluctuating

external temperatures. Air in a still or "dead" condition is the best of all the nonconductors of heat. The most perfect storage chambers are merely a series of structures to maintain a succession of dead-air blankets. Air is the best insulating substance, but its value depends on its stillness. If it is free to move in spaces of considerable size it will be in almost constant circulation, thereby causing convection currents which will carry outside heat into the storage chamber. Air spaces, therefore, should be narrow rather than deep, and should be built so tight that the air will be in the dead or still condition that makes it the best insulating medium. Chaff, chopped straw, sawdust, tan-bark, shavings, etc., on account of the air they contain, are good insulating materials, but they soon absorb moisture and decay in a comparatively short time. Quilts of various materials, such as hair, felt, mineral wool, flax fiber, and eel-grass, on account of the finely divided air they contain, make valuable materials for lining doors and also the walls of storage chambers. In the construction of inexpensive but efficient orchard storage houses it is our purpose to avail ourselves as far as possible of the use of earth and dead air. In furthering this end the hilly land of the apple region can supply a good insulating medium on practically three sides by having the first story of the house built deep into a hillside. The exposed side of the house should face the north, where it avoids the direct sun in the daytime and draws in the coldest air at night. The second story will be insulated by having hollow walls so as to afford one or more dead-air spaces.

DOORS AND WINDOWS.

Apertures for ventilation and the intake of cold air are necessary for air-cooled storage houses, but windows and doors should be reduced to the smallest possible number and size consistent with convenience. It is through the windows and the doors that most of the injurious rises in temperature gain access to the fruit. If electric light can be installed, there is practically no necessity of windows for lighting the storage chambers. If windows must be used, make them no larger than necessary, have the sashes fit very snug, and have one or more dead-air spaces between sashes. In all ordinary cases one door is sufficient both for putting in and taking out fruit. The doors of storage houses should be double thick, lined with builders' paper and filled with sawdust or some other suitable insulating material. Two such doors should be fitted so as to secure a dead-air space between them. The dead-air spaces between doors and windows and also in walls should not be over 2 inches deep. If air spaces are made larger, convection currents readily set up and carry heat into the storage chamber.

Figure 1 illustrates an air-cooled apple storage house built by Mr. J. R. Sams, Mars Hill, N. C., in the autumn of 1912. On March 17, 1913, Mr. Sams sent me by parcel post Stayman apples that had been

kept in this house. The apples were very large, having been grown on young trees, but they were in prime condition at that time. The varieties Delicious and Chicago were in good plump condition on May 9, 1913. Ben Davis and Black Bens kept up to June.

Figure 3 shows the ground floor plan of Mr. Sams' storage house. Figure 4 shows the plan of the second story.

The following are detailed specifications of construction:

"Built of first-class brick, tile drained around foundations. Double walls constructed of two layers of brick each, with dead-air space of 2 inches between walls. Storage chambers 32′ x 16′ x 8′, capacity 400 bar-

FIG. 1. Apple storage house of Mr. J. R. Sams, Mars Hill, N. C.

rels each. Three-foot double doors at east end of lower story. Four 9 x 9-inch ventilators on north side. Ventilators are plugged in hot and very cold weather with paper-lined, sawdust-filled plugs, as shown in Figure 2. Dirt floors with scantlings to support barrels.

"Upper story same dimensions as lower. Solid plank floor with slatted portions 15″ wide of 1″ x 2″ strips ⅝″ apart to allow for passage of air from lower story. Four flues below top joists with cover to regulate circulation of air connect with hooded flue at top of house. Small double windows in each end. Double-door entrance from roadway on south side. Spaces between joists on top of second story packed with 10 inches of sawdust."

This house was built for $600.

Figures 5, 6, 7, and 8 show the storage house of Mr. R. N. Barber of Waynesville, N. C. This house, 80′ x 30′ inside measurement, is built of rock masonry and plastered inside with cement. It is two stories high. The lower story is designed for fruit storage, while the room above is used for storage of cooperage stock and implements. The walls are of solid masonry 33 inches thick. The floor and ceiling of the apple storage chamber are of concrete 5 inches thick, the latter reinforced with railroad iron, rods, and woven wire. The only entrance to the storage chamber is through an 8′ x 7′ sawdust-filled door. The south side of the house sits in a hill, the earth insulating the entire height of the lower story. The north wall of the apple storage chamber is pierced with five windows. Each window has two sets of sash affording dead-air space between. A double-boarded, paper-lined shutter closes tightly over each window. The ventilating system of this house consists of three parallel concrete air ducts running the length of the building. The intakes,

Fig. 2. Air intakes and plugs of Mr. J. R. Sams' apple storage house.

2′ x 2′ x 2′, constructed of brick, form vertical wells which connect through the wall with the air ducts. The ducts are 12″ x 12″ inside measure and deliver air through wire-screened openings 6″ x 10″ at intervals of 5 feet. The air passes to the chamber above through similar openings in overhead ducts. See Figure 8. The flow of air through the house is controlled by plugs made to fit the openings. The capacity of the apple storage chamber is 2,800 barrels. Mammoth Blacktwig, Delicious, and Stayman apples kept satisfactorily in this house until May.

The storage house of Mrs. Moses Cone, Blowing Rock, N. C., shown in the frontispiece and in Figures 9, 10, and 11, is of three stories. The basement, 77′ x 25′ x 11′ inside measurement, has a solid masonry wall 20 inches thick, plastered with cement inside and out. This chamber has a capacity of 2,000 barrels. It has a 6-inch cement floor. The south side of the basement sits into a hill almost to the level of the second floor. Air is admitted to the storage chamber through openings 6″ x 12″ placed 8″ above the level of the floor. These openings have double air-tight shutters to control the flow of air into the chamber.

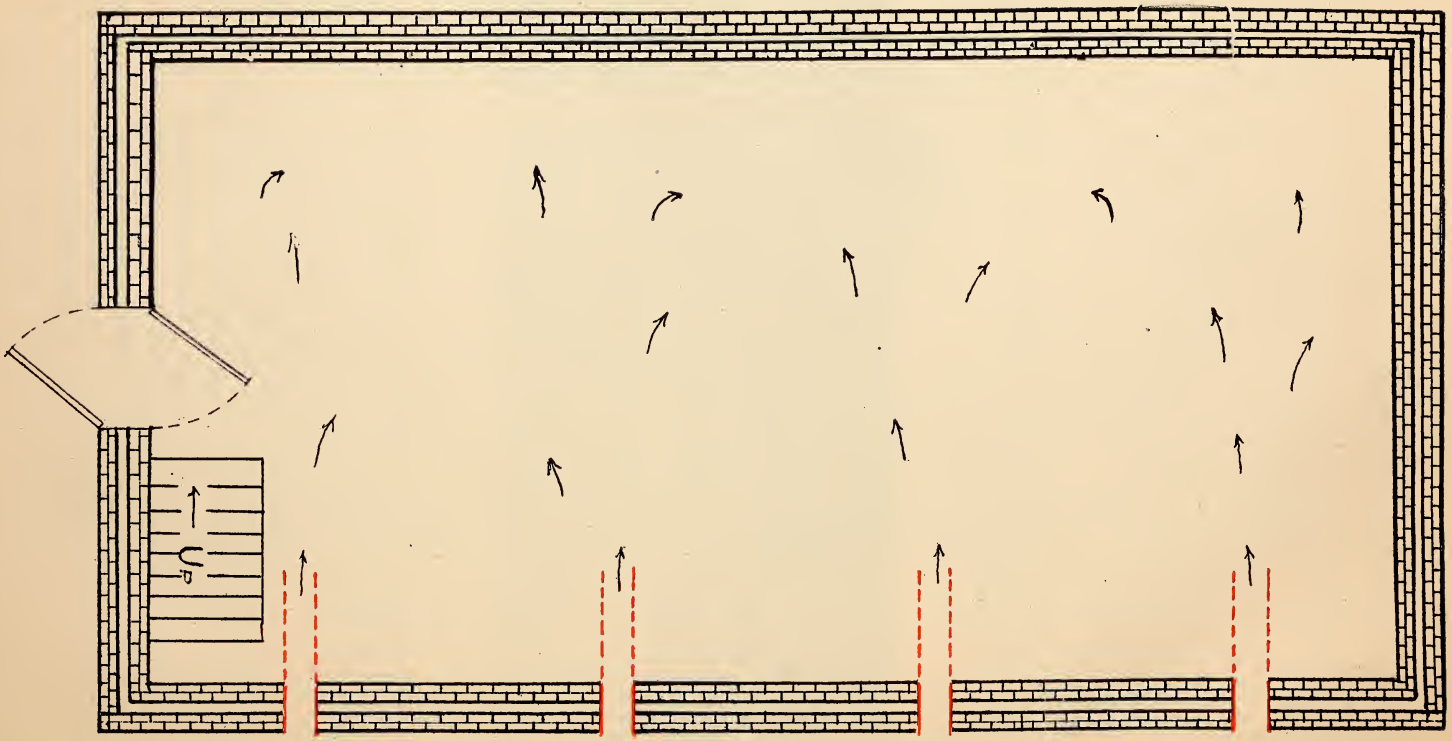

FIG. 3. Ground floor of Mr. J. R. Sams' apple storage house, showing ventilating system.

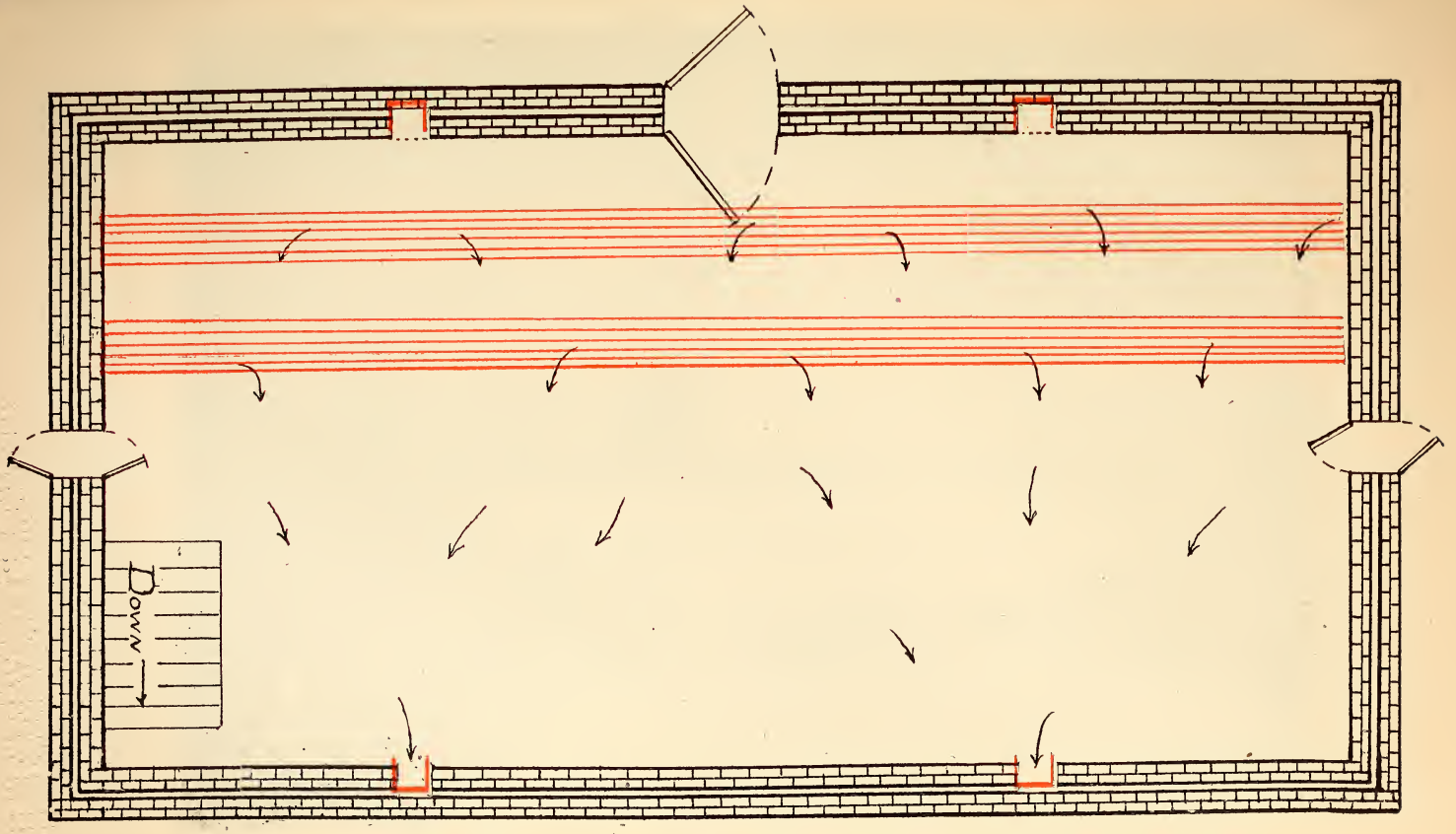

FIG. 4. Upper story of Mr. J. R. Sams' apple storage house, showing ventilation through slatted portion of floor.

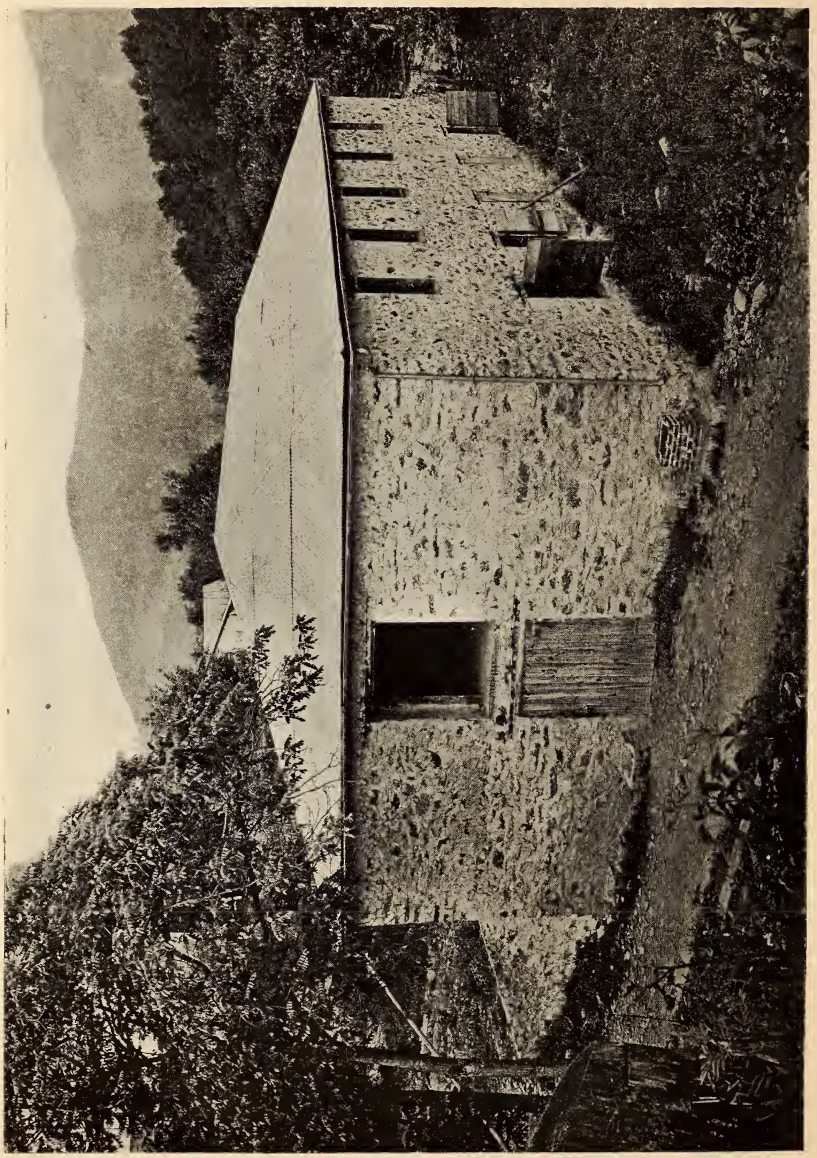

FIG. 5. Apple storage house of Mr. R. N. Barber, Waynesville, N. C.

The second story is constructed of 2 x 10 studding, double-boarded on the outside with storm sheeting, building paper, and weatherboard. The studding is sheathed on the inside with 1″ matched lumber. The floor of the second story is of single thickness laid on 2″ x 10″ joists, 18″ center between joists. The ceiling of this room is of similar construction with the walls. This room is designed as subsidiary storage. Twenty feet of it is cut off as a packing room, which has an elevator to the basement. The third story is a loft to accommodate packing materials. Three ventilators through the roof are connected by 18″ x 18″ air shafts, with similar openings in the ceiling of the second story. This draws the air from the basement through openings of the same size in the ceiling of the second floor. The openings are fitted with light, adjustable covers.

The materials used in the construction of this house are as follows: 40,000 feet lumber, 32 cubic yards stone, 460 sacks cement, 30 rolls building paper, 35 rolls roofing paper. Rough lumber cost $10 per M, weatherboard and flooring $20 per M.

Figures 12, 13, 14, and 15 illustrate the storage house of the Gold Medal Orchards of Oakwoods, Wilkes County, N. C.

The house is of two stories. The lower story, which is especially designed as the apple storage chamber, is placed deep in a hillside. The ends and part of the front are flanked with loose rock walls so as to give an almost complete earth insulation. See Figure 14. The lower story is entered from a road on the north, while the chamber above is approached by a road on the south side. The walls of the basement are of cement concrete and double so as to afford a dead-air space. The floor and ceiling are also of cement.

The upper story is of double wooden walls with air space between. It is designed as a subsidiary storage in case of extra crop, and is also used as a packing room and storage of boxes and barrels. All windows and doors are constructed so as to afford air insulation.

The ventilation system of this house consists of a box air duct which enters from the north side below the door and branches to four openings through the floor near the rear wall. The air is released from this chamber through two large capped vents in the ceiling above. When the damper in the air duct is opened the inrush of cool air will draw in a handkerchief held over the opening.

A self-recording instrument was placed in this house early in the storage period and a complete record of temperature and humidity kept until the last of the crop was disposed of on April 28th. Figure 16 is an illustration of the hygro-thermograph trace sheet for an average week of the storage period. Each day at 6 a. m. a man entered the house and marked by an **X** on the trace sheet the temperature at that time prevailing outside. To make a graphic representation of the range of outside temperatures these points have been connected by straight lines. The sheet therefore gives an exact record of the temperatures maintained by

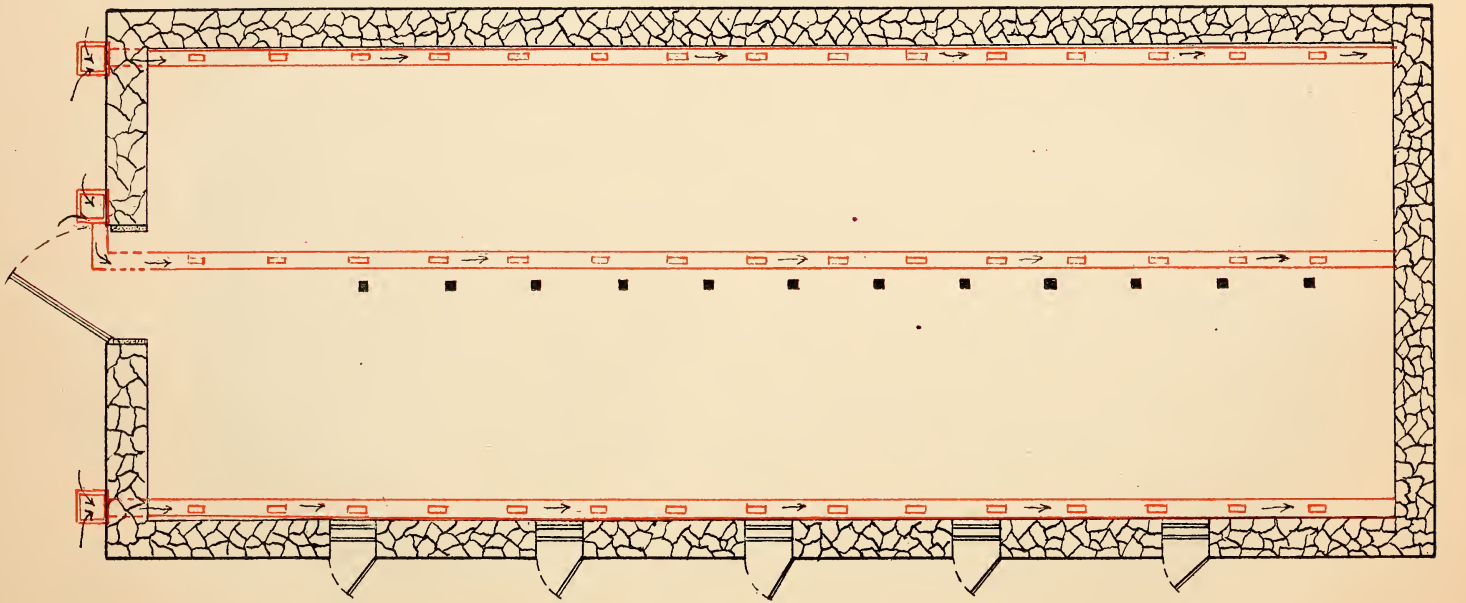

FIG. 6. Storage chamber of Mr. R. N. Barber's apple house, showing ventilating ducts.

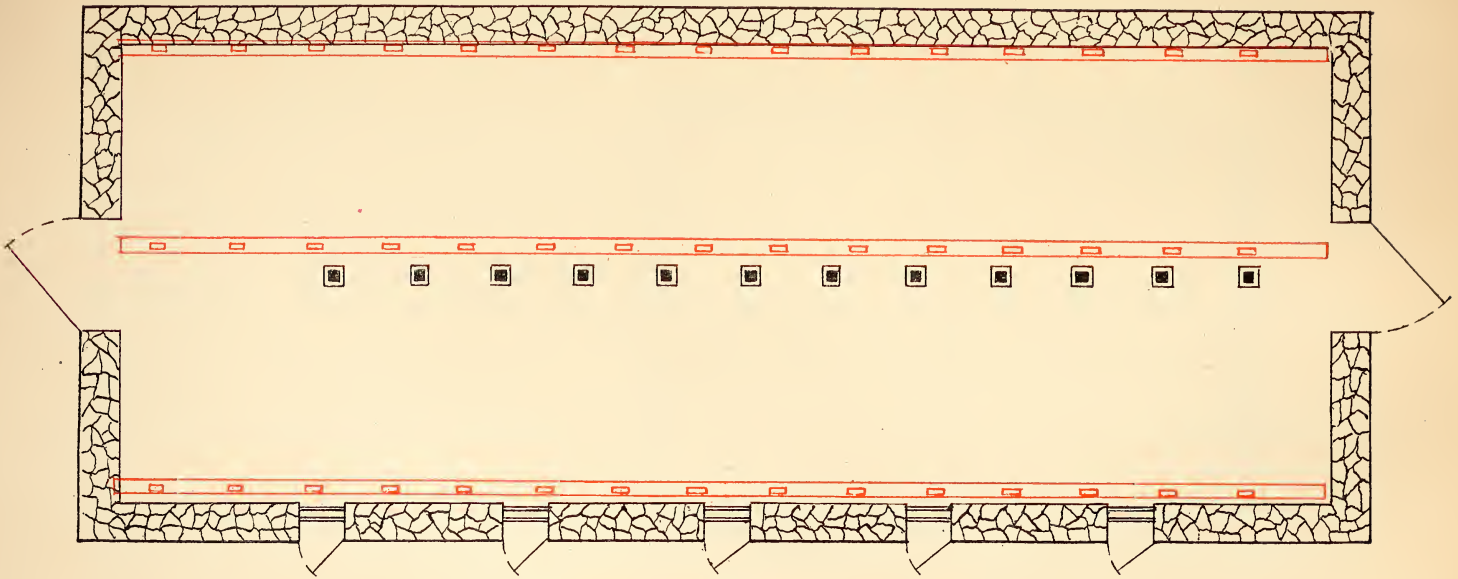

FIG. 7. Second story of Mr. R. N. Barber's apple house.

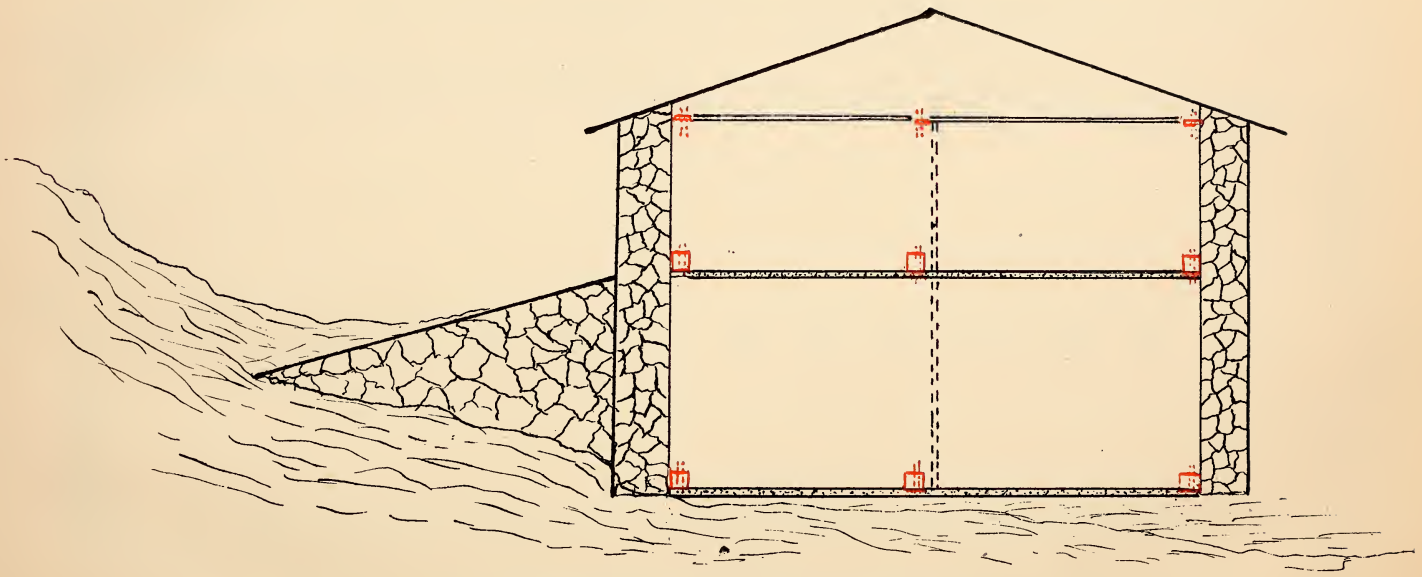

FIG. 8. Cross-section of Mr. R. N. Barber's apple house.

the storage chamber as compared with the fluctuations of temperatures outside. It will be noted that the week began with an outside temperature of 39° and was comparatively stable until Friday morning, when it ran away up to 61°, an increase of 22 degrees. By Sunday it had dropped 13 degrees, and on Monday, owing to a cold wave, it went down to 24°. During the week the outside temperature ranged from 61° to 24° or a variation of 37 degrees. During these outside variations the inside temperature maintained an almost even line from 42° on Tuesday to 48° on Sunday, when it dropped to 37°, when the ventilators were opened to admit the cooler outside air. In comparison with an outside variation of 37 degrees, the storage chamber showed a total variation of only 11 degrees. As warm air holds more moisture than cold air, it will be seen that the humidity record varies proportionately with the temperature.

For the past two seasons this air-cooled storage house of the Gold Medal Orchards has kept Red Limbertwigs in good condition up to May 1st. This year a part of the crop was carried to May 15th and sold at very handsome prices.

Figure 17 shows a photograph of a box of Red Limbertwig apples taken from this storage on March 12th. It will be noted that they are in the pink of condition at that time.

Figure 18 shows the air-cooled apple storage house of the Triangle Orchard Company at Poors Knob, Wilkes County, N. C. Figure 19 shows the ground plan of this house. The broken lines indicate the ventilating system. The specifications of this house as given by the owners are as follows:

Dimensions.—The interior dimensions to be 30 feet frontage by 20 feet deep by 9 feet high in the clear. See Figure 19.

Excavation.—The excavation to be made in a side hill and sufficiently deep into the hill to have the side walls of the house well covered with dirt.

The three dirt walls of excavation to be perfectly smooth and plumb.

The floor to be perfectly level, and treuches 12 inches deep to be excavated on all four sides to receive the foundation.

Part of the dirt excavated to be used to make an 8-foot wide fill (faced with rock) in front of house and level with floor.

Concrete.—The concrete to be a 1-3-5 mixture, one part of cement, 3 of clean-cut sand that will pass through a ¼-inch mesh screen, and 5 parts of sharp broken rock not over 2½″ in size.

Walls.—Rear concrete wall to be 12″ thick, side and front concrete walls 16″ thick.

The front wall to have wooden blocks buried in same at regular horizontal intervals of 4 feet and three in each per row and placed flush with inner surface. Blocks to be shaped and set as shown in Figure 20 and to receive 2x4 uprights nailed to same. These 2x4 pieces are to be ceiled over with ¾″ boards, and on this two layers of Cabot's Double Ply "Quilt"* laid crosswise with each other are to be nailed. This to be ceiled over again with ¾″ stuff. See Figure 20.

*Cabot's quilt, an excellent insulating material, is manufactured by Samuel Cabot, Boston, Mass. It is made of eel-grass, a long fiber of great durability and resistance to fire. Being a sea plant and containing a large per cent of iodine, it is therefore a repellent to rats and vermin.

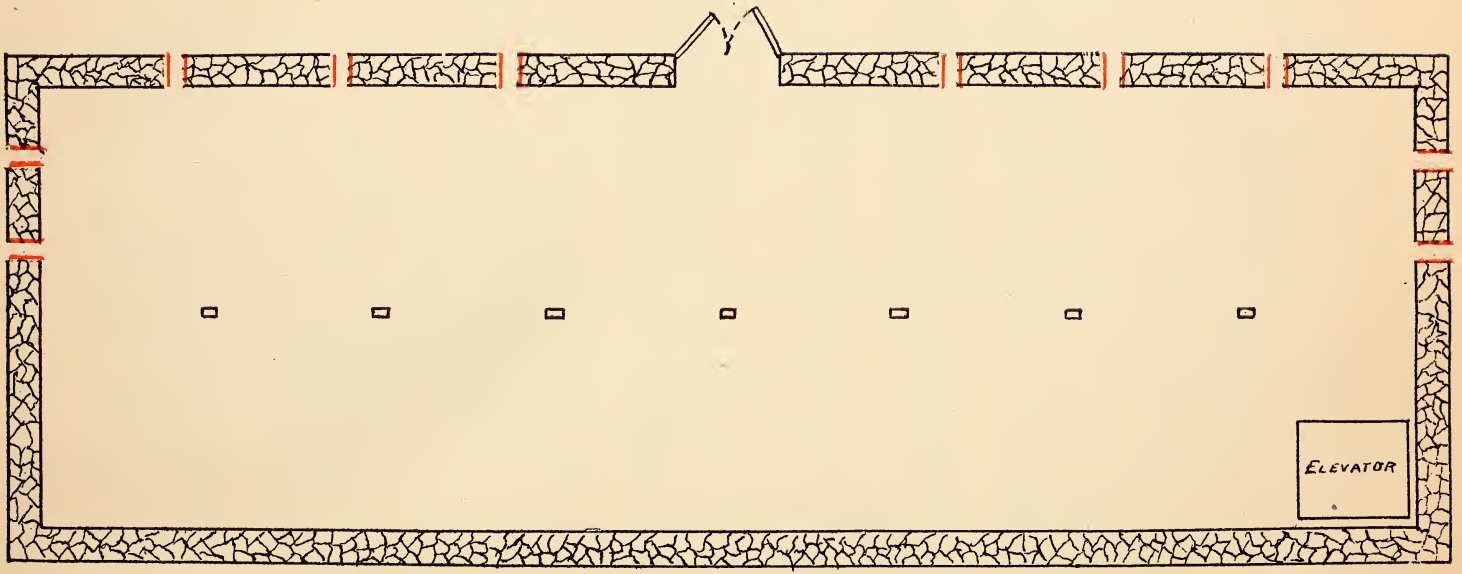

FIG. 9. Storage chamber of Mrs. Moses Cone's apple house at Blowing Rock, N. C.

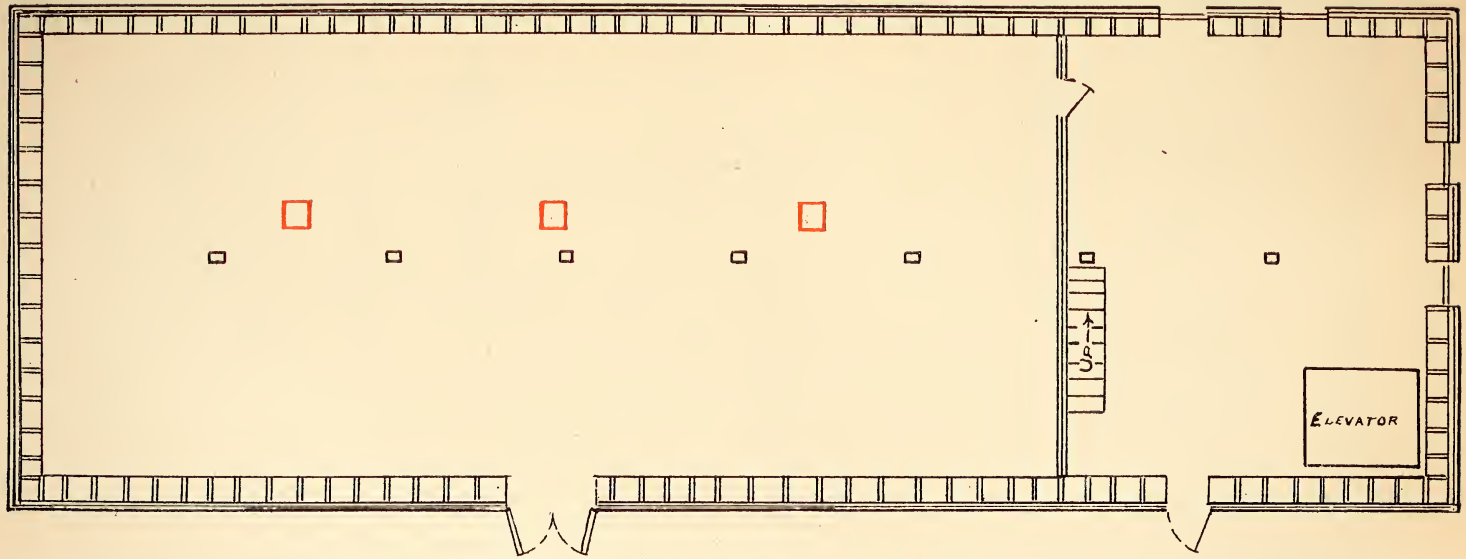

FIG. 10. Packing-room and subsidiary storage chamber of Mrs. Moses Cone's apple house.

Ceiling.—The ceiling joists to be pine 8″x10″x10′6″ long, resting on center of the two side walls and supported by two 8″x10″x9′ pillars. These latter to rest on concrete foundations 12″x14″ on top and 18″x20″ on base 14″ high.

The ceiling joists to be pine 2″x12″x11′, spaced 18″ centers.

These are to be ceiled underneath with ¾″ boards and on the under side of them two layers of Cabot's Double Ply "Quilt" laid crosswise with each other are to be nailed. This to be ceiled again with ¾″ stuff.

Roof.—The roof to be a good three-ply rubber roofing, laid on well matched boards with single slope towards front and a pitch of 1 in 4. The roof (rafters) to be 2x4 spaced 2 feet between centers. The roof to extend 4 feet over front wall of building.

Doors.—There are to be two doors, each swung towards the outside and from the inner and outer sides of the front wall. Doors to be double boarded, interlined with "Quilt" and to have a 4-light 10x12 sash in each.

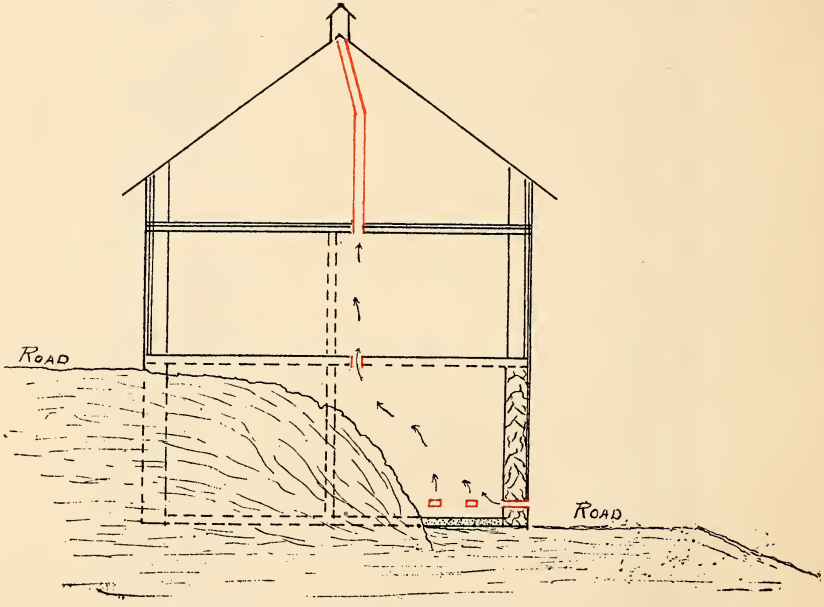

FIG. 11. Cross-section of Mrs. Cone's apple house, showing position in hill and ventilating system.

Windows.—There are to be two windows in the front wall, each window to be two 10x12, sash nailed in place flush with the inner and outer side of the wall and with a dead-air space between.

Floor.—To be dirt and left perfectly level.

Intake.—There will be a wooden air intake on each outer side of the building, said intake to be 8″x12″ inside measurements and made of 2x12 pine painted with two coats of asphalt paint. These will extend to the outer edge of the loading platform and to have a hinged door swung from top. The outer opening to be screened for protection against mice or other animals. These intakes will pass through the side walls flush with the floor and on the inside of the house will have three outlets, one at center of side wall and the other two at rear and front walls one-third the distance of same from side wall.

Draft Tubes.—There will be two draft tubes 12″x24″ each in the clear placed in the center of the ceiling and equidistant from the end walls and each other. They are to have hinged doors on the bottom, extend 4 feet above the roof, be roofed over and screened on top to prevent animals from entering.

Loading Platform.—There will be a wooden loading platform 6 feet wide running from the door over the 8-foot dirt fill and protruding 12 feet over this fill, to allow wagons to drive up close and permit of easy loading.

Rubblewall.—At ends to protect dirt covering at sides.

Very careful thermograph records were kept in this storage house from December 16, 1913, to April 20, 1914, when the last load of fruit was sold. Standard Weather Bureau maximum and minimum thermometers were used both on the inside and on the outside of the house to make comparisons of temperature with the thermograph inside. This gave an accurate record of temperature changes throughout the storage period of seventeen weeks. The following table gives a record by week of the temperatures in the storage chamber in comparison with those outside:

RECORD OF MAXIMUM AND MINIMUM TEMPERATURES AT TRIANGLE ORCHARD COMPANY STORAGE HOUSE.

Week Ending	Outside.		Inside.		Variations.	
	Maximum.	Minimum.	Maximum.	Minimum.	Outside.	Inside.
Dec. 21	58	28	46	38	30	8
" 29	59	21	46	38	48	8
Jan. 4	41	29	39	37	12	2
" 11	63	21	[1]44	38	42	6
" 18	57	16	43	37	41	6
" 25	65	23	46	38	42	8
Feb. 1	68	29	[2]52	40	39	12
" 8	65	19	48	39	46	9
" 15	48	16	42	37	32	5
" 22	57	14	45	37	43	8
Mar. 1	55	14	43	35	41	8
" 8	62	16	41	35	46	6
" 15	56	22	40	34	34	6
" 22	68	21	[3]47	36	47	11
" 29	79	23	[4]52	35	56	17
Apr. 5	70	31	[5]52	41	39	11
" 12	70	31	[6]52	38	39	14

[1]Several men sorting apples in house; weather hot outside.
[2]Carpenter working in house, left door open.
[3]A couple of hot days and five men in house packing and shipping apples.
[4]Working in house.
[5]Warm weather and taking out fruit.
[6]Warm weather and taking out fruit.

It will be noted that when the house was not opened for packing or shipping fruit, that the temperature was remarkably uniform, not varying over 8 degrees for the week, while at the same time the outside tem-

FIG. 12. North elevation of Gold Medal Orchards' apple storage house at Oakwoods, N. C.

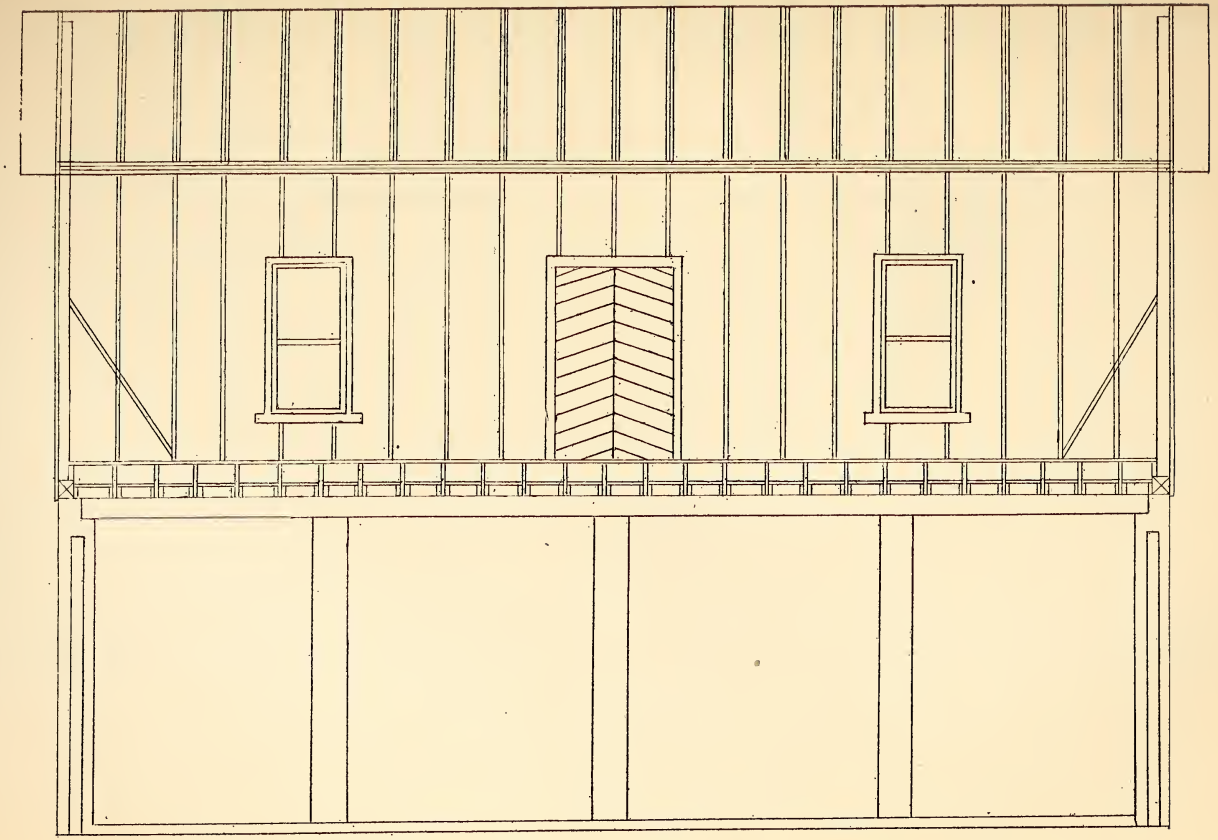

FIG. 13. South elevation of Gold Medal Orchards' apple storage house.

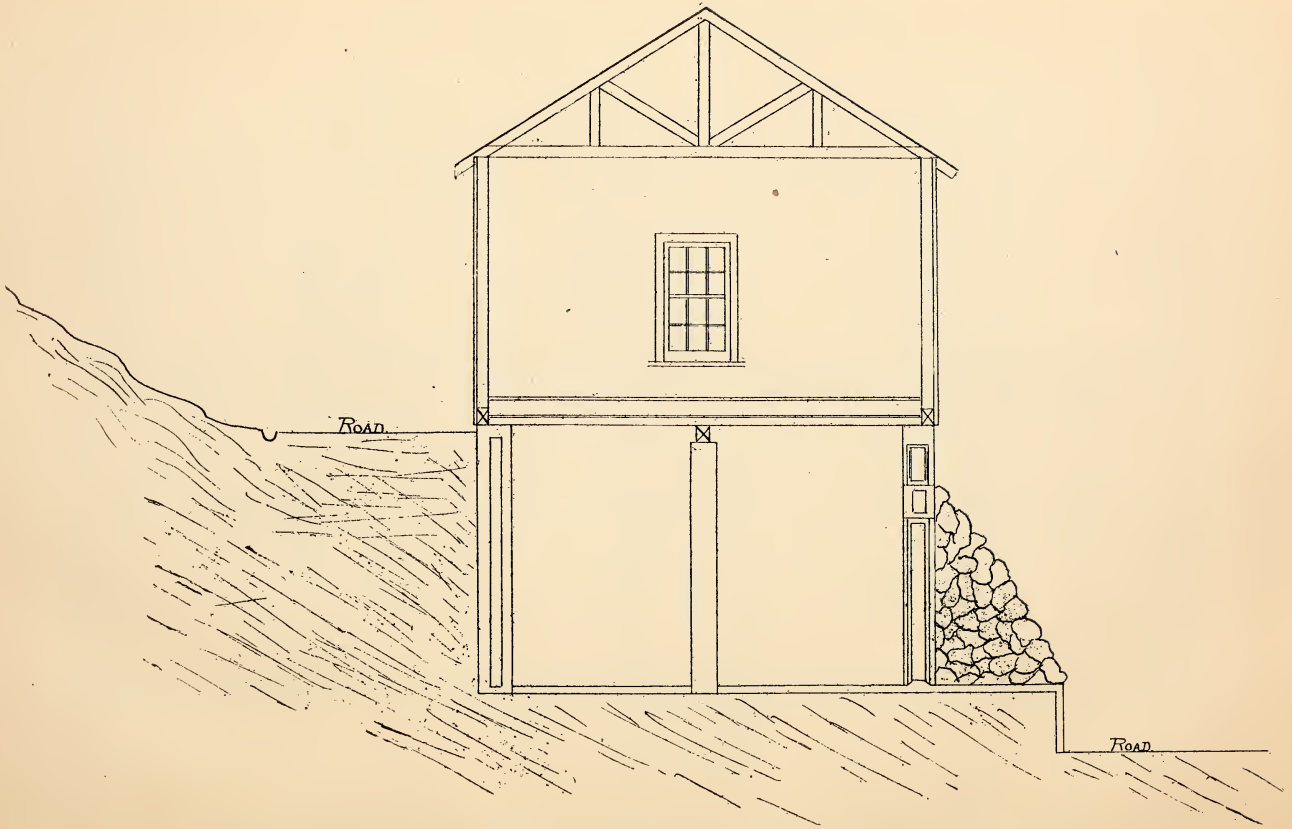

FIG. 14. Cross-section of Gold Medal Orchards' apple storage house, showing earth insulation and position of roads.

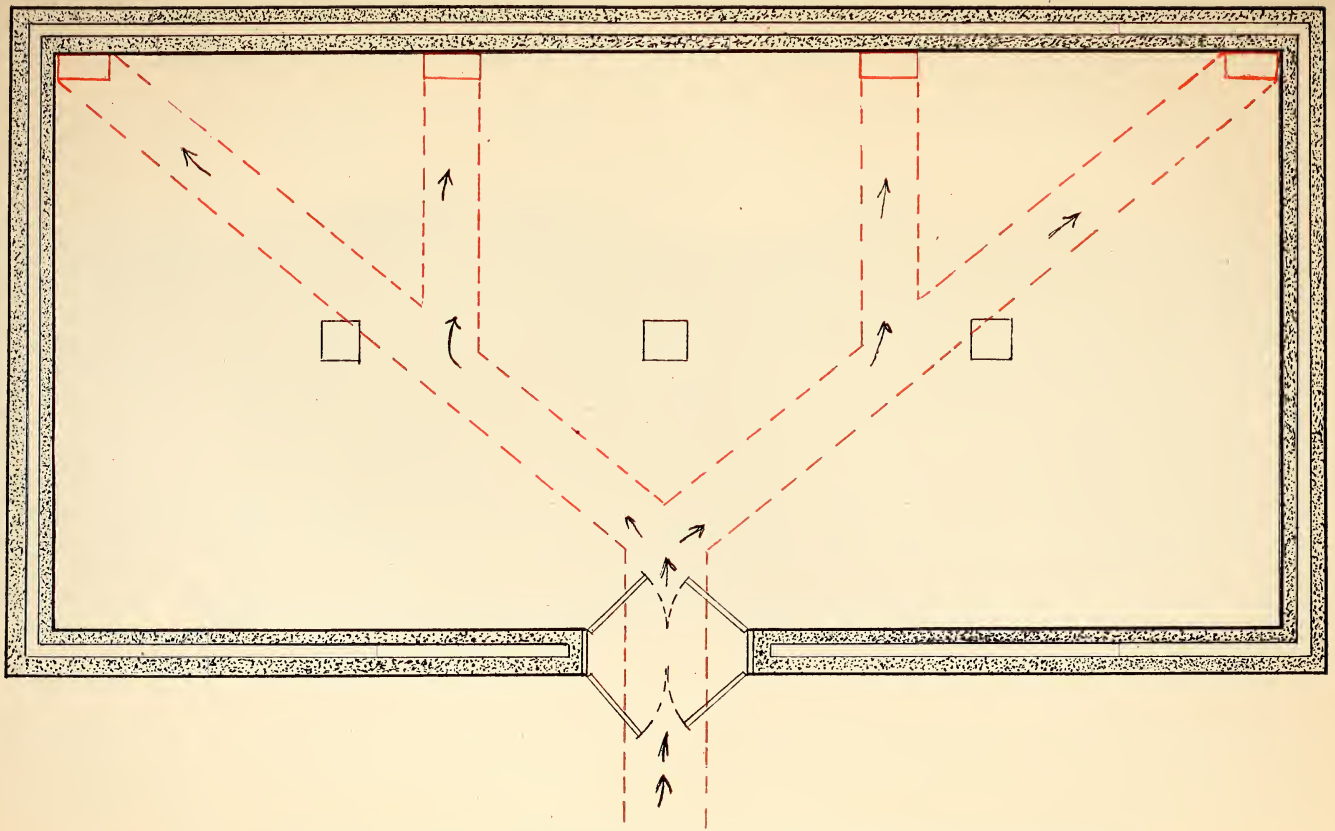

FIG. 15. Ventilating system of air-cooled apple storage house of Gold Medal Orchards, Oakwoods, N. C.

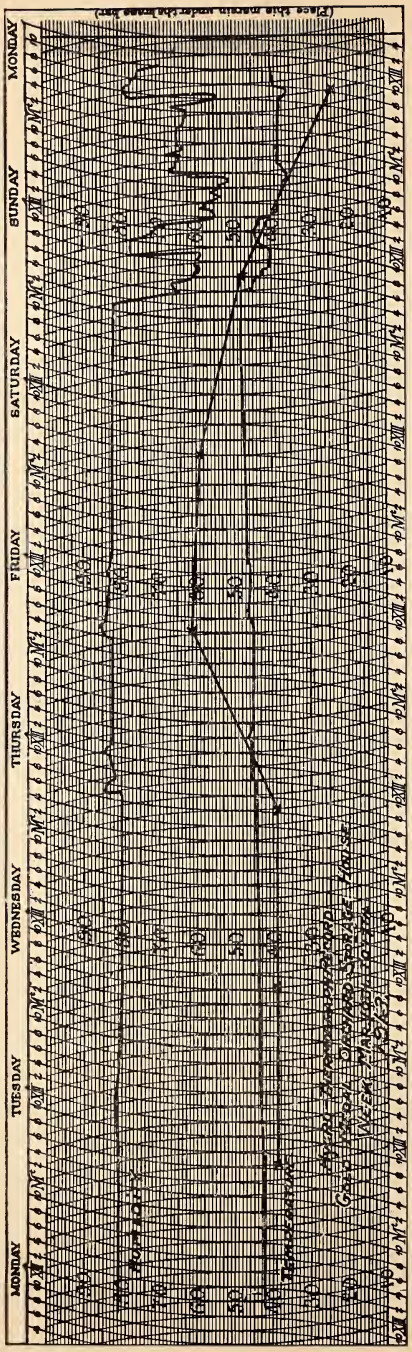

FIG. 16. Hygro-thermograph trace sheet.

perature varied as much as 48 degrees. Towards the end of the storage period, owing to warm spring days and the fact that fruit was being shipped almost every day, there was a marked rise in temperature within the storage chamber. Red Limbertwig apples kept well and were sold during the latter weeks of the storage period at $6.50 per barrel for No. 1 and $5.50 per barrel for No. 2, f. o. b. shipping point. As the prices at picking time were $3 and $2.50 per barrel for No. 1 and No. 2, it will be seen that the storage house was an excellent investment. Figure 21 is a photograph of a parcels post package of apples sent from this storage house February 25th. The perfect condition of the fruit is easily seen.

FIG. 17. Box of Red Limbertwig apples taken from storage house of Gold Medal Orchards, March 12, 1914.

The house has an earth floor on which several buckets of water were thrown each week to maintain the humidity sufficient to keep the fruit crisp and plump. The storage house with cement floor owned by the Gold Medal Orchards was found to be too dry, and it was difficult to keep the fruit from shriveling.

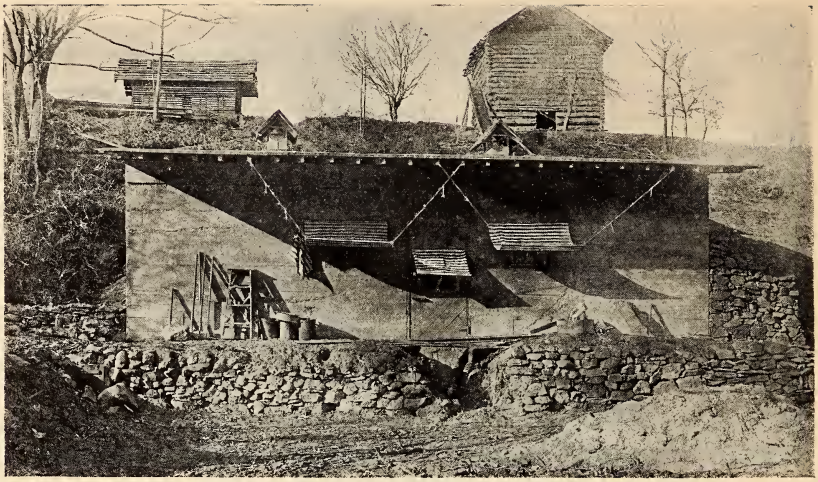

FIG. 18. Air-cooled apple storage house of Triangle Orchard Company, Poors Knob, N. C.

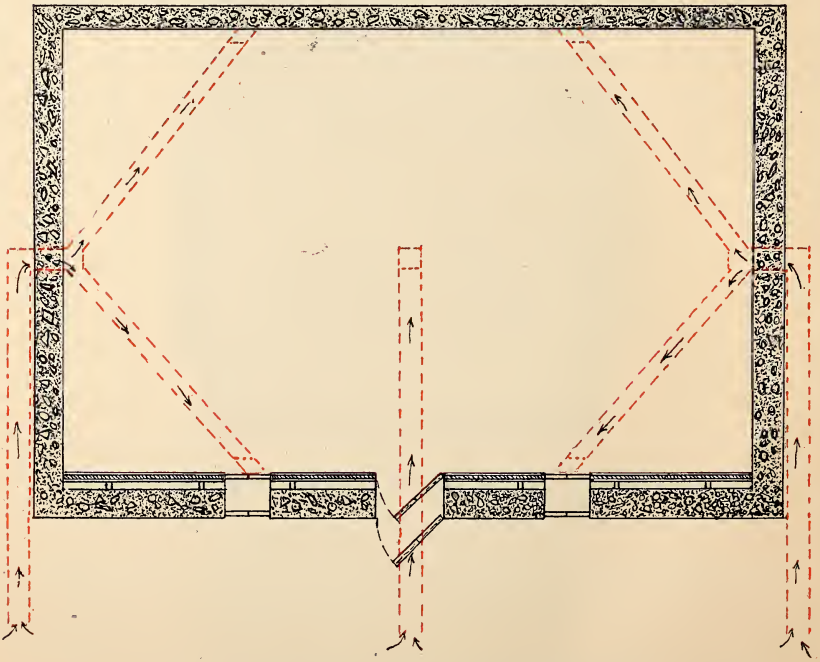

FIG. 19. Plan of storage chamber of apple house of Triangle Orchard Company, showing construction of walls and ventilating system.

MATURITY OF APPLES FOR STORAGE.

Apples when ready for picking should be fully grown and highly colored. This is known to the grower as the "hard ripe" stage. If on lifting an apple it snaps off from the twig without breaking the stem, it is ready for picking. If left longer on the trees there will be danger of loss from overripes and windfalls. In picking apples, they should not be separated from the twig by a straight pull, but a nip upwards or sideways will remove the fruit from the twig without breaking or tearing out the stem.

Pears should be picked from the trees in a more immature stage than apples. They should be of full size, but entirely green and showing none of the yellow color. The separation of the stem from the twig, as with the apple, is a good test of picking condition with pears.

MANAGEMENT OF AN AIR-COOLED APPLE STORAGE HOUSE.

It is without doubt of great importance to have a storage chamber well constructed to secure as perfect insulation as possible. It is, however, even more important to have such a house carefully handled to secure a cool and constant temperature. It is notable in practical cold-storage work that a good house poorly handled cannot compete with an inferior house well handled.

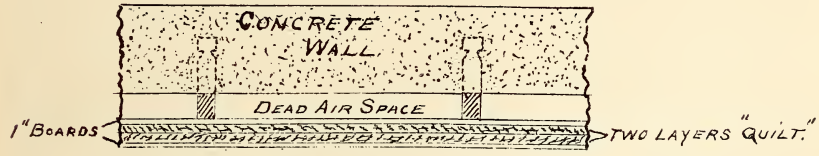

FIG. 20. Detail construction of wall of Triangle Orchard Company's apple storage house.

In preparation for the crop, advantage should be taken of every cool night to reduce the temperature of the storage chamber as low as possible. The ventilators should be opened after sundown and the whole house closed tightly before sunup so as to keep out the warm day air. If the house has been used for storage before, the interior and all boxes and barrels except new ones should be thoroughly sprayed with Bordeaux mixture. This will destroy all germs of decay that may have been carried over from last year's crop. Each day as the fruit is picked it should be placed in boxes or barrels and hauled to the packing house. It should not be put in the packing house in the evening, but left outside to cool down in the night air, and be put in the house before sunup in the morning. This practice will greatly conserve the cool temperature of the house and also keep the fruit from sweating in storage. As the weather

becomes cooler, advantage should be taken of it to lower the temperature and cool down the fruit as much as possible. When all the fruit is in, the house should be opened as little as possible and the fruit left wholly undisturbed. Practical cold-storage men differ as to what is the proper

FIG.. 21. Parcel-post package of apples sent from Triangle Orchard Company's storage house, February 25, 1914.

FIG. 22. Well-sprayed apples which dried up with age instead of rotting.

temperature at which fruit should be stored, but a general consensus of opinion as evidenced from time to time in the columns of *Ice and Refrigeration* shows that apples should be stored at a temperature of 30° to 40° and pears 33° to 36°. In an air-cooled storage it is, of course, not

FIG. 23. Sorting apples for storage at Gold Medal Orchards, Oakwoods, N. C.

possible to maintain as low or as constant a temperature as under ice or mechanical refrigeration, but the fruit should be kept as cool as possible without freezing.

According to cold-storage authorities, the successful storage of fruit depends on four conditions:

1. Well-sprayed, carefully-handled fruit.
2. A low temperature.
3. An even temperature.
4. Sufficient moisture to prevent shrinkage and keep the fruit crisp and plump.

No fruit should ever be placed in storage that has not been thoroughly sprayed. In rare instances unsprayed fruit may look as sound as the sprayed product, but experience has shown that it never keeps as well. The spraying seems to disinfect the fruit so thoroughly that it has great resistance to external bacteria. On May 10th a Buckingham apple was sent me which at that late date showed not a sign of fungous injury. This well-known autumn variety is in prime eating condition about September 15th. This apple had been so thoroughly sprayed that there were no germs of decay about it, and when its season was past it simply dried up instead of rotting. Figure 22 shows four well-sprayed Red Limbertwig apples that stayed on my desk without decay until they became dried apples. Fruit showing bruises, fungous or insect injury, or other signs of decay, should never be placed in storage. Though it may temporarily delay its deterioration, a cool temperature will not prevent the ultimate decay of overripe or unsound fruit. Fruit should not be piled in the orchard and left to ripen, but should be placed in storage the morning after it is taken from the tree. The time elapsing between picking and storing very largely determines the life of the fruit.

Since air-cooled storage houses are ventilated incidentally in reducing the temperature, there is usually more than enough circulation to carry off all vitiated air and excess moisture from the ripening and drying out of the fruit. There is therefore practically no danger of damp, stagnant air causing moulds and rots on the fruit. There is, however, danger on the other hand of the fruit becoming too dry and shriveling. The fruit should be carefully watched during the storage period, and if found to be shriveling, water should be placed on the floor and allowed to evaporate to raise the humidity of the air about the fruit.

Of course, it should not be attempted to store fruit in bulk. It is impossible to properly ventilate a pile of fruit, and such handling could only result in loss in any kind of storage house. With fruit for immediate sale or for short storage it is best to box or barrel at once. Fruit keeps well in tight packages, especially if wrapped; but if held in storage for several months it will be necessary to repack before shipping in order to make up the shrinkage from drying out and have the packages full. For long storage in air-cooled houses most growers make a practice of

sorting the fruit into ventilated boxes at picking time and piling these up in the storage chamber layer on layer with scantlings between. Figure 23 shows fruit being boxed for storage in the Gold Medal Orchards at Oakwoods, Wilkes County, N. C. The fruit is not handled at all in storage, but is left wholly undisturbed until it is packed for shipping.

Wrapping of fruit for storage retards ripening and lengthens the keeping quality. There is also less loss of moisture. If a fruit happens to decay, the wrapper localizes the infection and prevents its spread to neighboring fruits. The wrapping of fruit is to be recommended for the storage of extra fancy fruit.

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BULLETIN 229 FEBRUARY, 1915

NORTH CAROLINA

AGRICULTURAL EXPERIMENT STATION

CONDUCTED JOINTLY BY THE

STATE DEPARTMENT OF AGRICULTURE

AND THE

COLLEGE OF AGRICULTURE AND MECHANIC ARTS

RALEIGH AND WEST RALEIGH

FERTILIZER EXPERIMENTS WITH CORN ON PIEDMONT CECIL SANDY LOAM SOIL

AND

VARIETIES, CULTURE AND FERTILIZATION OF CORN ON PIEDMONT CECIL SANDY LOAM AND RED CLAY SOILS

Bulletins of the Station Will be Sent Free to Citizens of the State on Request

THE NORTH CAROLINA
AGRICULTURAL EXPERIMENT STATION

CONDUCTED JOINTLY BY THE

STATE DEPARTMENT OF AGRICULTURE

AND THE

N. C. COLLEGE OF AGRICULTURE AND MECHANIC ARTS

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1In coöperation with the U. S. Department of Agriculture, Bureau of Plant Industry.
2In coöperation with the U. S. Department of Agriculture, Bureau of Soils.
3In coöperation with the U. S. Department of Agriculture, Bureau of Animal Industry.
4In coöperation with the U. S. Department of Agriculture, Office of Experiment Stations.

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†Deceased.

INTRODUCTORY STATEMENT

In 1900 plans were made and work begun in a systematic study of the soils of the State, including soil survey; chemical and mechanical soil analyses; field experiments to determine the adaptability of the different crops to the different type of soils; and experiments to determine the fertilizer or plant food requirements of various crops when grown on the different leading types of soil found in the State. The plans were carefully matured, made uniform and have been carried out on the Experiment Station Farm at Raleigh, and on the several test farms located on the main soil types of the State.

This report covers experiments with corn at the Experiment Station Farm, for the years 1902-'09, inclusive, together with a discussion of the results. C. B. Williams and B. W. Kilgore, are responsible for the plans and conduct of the work in 1902-'07; and C. B. Williams in 1907-'09. B. F. Walton, William Kerr and A. R. Russell, successively as superintendents of the Station Farm, have had charge of the culture and handling of the crop, and W. F. Pate and F. N. McDowell have rendered valuable aid in putting the results in tabular form. C. B. Williams is responsible for the form, for the conclusions, and for the writing of the report.

Under this plan the following reports have been issued:

1. Preliminary Report on the Soil Survey Work in the State, and Fertilizer, Culture and Variety Tests of Cotton, Corn, Irish and Sweet Potatoes, Grasses and Grains. (Edgecombe Test Farm. Department of Agriculture Bulletin, November, 1900.)

2. Fertilizer, Culture and Variety Tests of Cotton and Corn, and Experiments on Black or Pocoson Soils. (Edgecombe Test Farm. Department of Agriculture Bulletin, January, 1902.)

3. Fertilizer Experiments with Cowpeas on Piedmont Red Clay Loam Soil, and Varieties and Culture of the Cowpea on this Soil. (Iredell Test Farm. Department of Agriculture Bulletin, June, 1900.)

4. Fertilizer Experiments with Cotton on the Piedmont Red Clay Loam Soil, and Varieties and Culture of Cotton on this Soil. (Iredell Test Farm. Department of Agriculture Bulletin, August, 1910.)

5. Fertilizer Experiments with Corn on the Piedmont Red Clay Loam Soil, and Varieties and Culture of Corn on this Soil. (Iredell Test Farm. Department of Agriculture Bulletin, September, 1910.)

6. A Preliminary Report on the Mountain Soils. (Department of Agriculture Bulletin, May, 1911.)

7. Fertilizer Experiments with Cotton on Norfolk Sandy Loam Soil, and Varieties and Culture of Cotton on this Soil. (Edgecombe Test Farm. Department of Agriculture Bulletin, April, 1914.)

8. Fertilizer Experiments with Cotton on Piedmont Cecil Sandy Loam Soil and Varieties and Culture of Cotton on this Soil. (N. C. Experiment Station Bulletin, No. 227, April, 1914.)

I. FERTILIZER EXPERIMENTS WITH CORN ON PIEDMONT CECIL SANDY LOAM SOIL

AND

II. VARIETIES, CULTURE AND FERTILIZATION OF CORN ON PIEDMONT CECIL SANDY LOAM, RED CLAY AND VALLEY SOILS

Being a Report of Work With Corn on the Experiment Station Farm in 1902-09, Inclusive

By C. B. Williams, B. W. Kilgore and A. R. Russell.

GENERAL SUMMARY OF RESULTS OF FERTILIZER TESTS.

1. The right fertilization of corn has paid moderately well on the Cecil sandy loam and clay loam soils of the State. What this fertilization should be on this and similar soils is shown by the results of our experiments as given on the following pages.

2. For the production of corn on this land the use of a mixture carrying normal amounts of phosphoric acid and nitrogen gave an average increased yield of shelled corn per acre of 69 per cent over the yield secured on the same character of land without fertilization. The net profit, over cost of fertilizer, of this combination was $6.60 per acre.

3. Where a normal amount of potash was used with phosphoric acid in place of the nitrogen, there was an average decrease in yield of 8½ per cent of shelled corn. The average profit for the P K application over cost of fertilizer was $6.17 per acre.

4. On an average the use of a fertilizing mixture carrying normal amounts of nitrogen and potash was used with only a very small gain in yield and at a loss of 86 cents per acre.

5. Nitrogen, phosphoric acid, and potash combined in a complete fertilizer yielded on an average slightly less than when the potash was left out of the mixture. The experiments, as a whole, show that phosphoric acid and nitrogen are the predominant or controlling plant food constituents for increasing yields and adding to profits in growing corn on this soil. It would appear from the average results that potash was not nearly so essential.

6. The average results of both fields show that lime alone was used at a very small profit, while used in combination with nitrogen, phosphoric acid and potash to make a complete fertilizer, it has shown up on an average to much better advantage, the gain in yield being equal to a profit of 86 per cent. Taking all the results as a whole, the indications are that in growing corn on this soil under similar conditions to those obtaining in these experiments, lime will generally be needed for the largest yields and greatest profit per acre.

7. The amount of nitrogen in the normal fertilizer (300 pounds per acre), applied in the corn experiments was 3 per cent or 9 pounds to the acre. This amount was varied so as to give 4½, 9, 18 and 27 pounds of this constituent per acre. The results emphasize the importance of nitrogen for the production of corn on this soil when applied in connection with a good amount of phosphoric acid and some potash. The larger the amount of nitrogen the greater was the yield, and the more profit per acre was secured. The average yield of corn during eight years on the plats, receiving three times the normal quantity of nitrogen with normal quantities of phosphoric acid and potash (N_3 P K), was 24.4 bushels per acre and the average increase over unfertilized plats was 15.2 bushels. This fertilizer application cost $7.35 per acre, making the cost of fertilizer per bushel of increase of corn, 48 cents.

8. The amount of potash in the normal fertilizer (300 pounds per acre), used was 1½ per cent, or 4½ pounds per acre. This amount was varied so as to apply 2¼, 4½, 9 and 13½ pounds per acre respectively. The results on an average show that the larger quantities were not as profitable as were the use of half normal amounts. However, the results for the two fields are not in agreement as to the most profitable percentage of potash to use in the mixture. In Field A the half normal potash (equal ¾ per cent in the 300 pounds used per acre), while in Field B the twice normal application of potash (equal 3 per cent in 300 pounds used per acre), were indicated to be the most profitable amounts of this constituent to use.

9. The amount of phosphoric acid in the normal fertilizer (300 pounds per acre) used was 7 per cent or 21 pounds of phosphoric acid per acre. This quantity was varied so as to apply 10½, 21, 42 and 63 pounds respectively of phosphoric acid per acre. These amounts of phosphoric acid would be supplied by 65.6, 131.2, 262.4 and 393.6 pounds respectively of 16 per cent acid phosphate. The results show that the largest yields, increases and profits per acre to have come from the use of 262.4 and 393.6 pounds of acid phosphate, or 42 and 63 pounds of phosphoric acid per acre.

10. Varying the amounts of the normal fertilizer application from 150 to 900 pounds per acre gave increased yields and profits for all the applications the most profitable returns on an average resulting from 150 pounds of fertilizer per acre. After paying for the fertilizer itself the following profits were obtained from different quantities of fertilizer:

150 pounds of fertilizer per acre gave a profit for corn and stover of $7.88;

300 pounds of fertilizer per acre gave a profit for corn and stover of $5.21;

450 pounds of fertilizer per acre gave a profit for corn and stover of $6.94;

600 pounds of fertilizer per acre gave a profit for corn and stover of $6.49;

900 pounds of fertilizer per acre gave a profit for corn and stover of $5.64.

11. In comparisons of dried blood and nitrate of soda as sources of nitrogen, the total yields and increased yields over unfertilized plats was quite uniform in showing a slight advantage in favor of the latter. The average of the results show too that better profits were secured when the nitrate was divided, applying one-half at planting with the acid phosphate and manure salt and reserving the other half and applying as a side dressing about July 1. It should be remembered that in dividing the application a slightly greater expense will be incurred in making the two applications over what it would cost to make the entire nitrate application at planting with the carriers of phosphoric acid and potash. Stable manure showed up particularly well on this soil as a source of nitrogen for corn.

12. When 300 pounds of fertilizer was applied in the drill at the ordinary depth; in the drill about 4 or 5 inches below the seed; broadcast before planting; and, divided into two equal parts, one-half being applied in the drill before planting and the other as a side dressing about July 1, the deep application and dividing the applications gave the largest yields and profits per acre.

13. Taking the conclusions under 11 and 12 together it is seen that where 300 pounds of fertilizer is used to the acre on this character of soil, the best and most economical methods are by deep application and by dividing the application.

14. Our soil analyses of the various soils of the State indicate that these results will apply to the red (Cecil) clay loams, red (Cecil) clays and valley soils of the Piedmont, and in like manner the soil analyses and experiments on the mountain soils indicate that the results will apply to this section of the State also.

15. For the production of corn on this soil, taking the results here reported as a whole, it is recommended that 150 to 300 pounds of fertilizer be used per acre. The fertilizer can be applied in the drill before planting, though it is preferable to divide the application into two parts, putting out one-half in the drill before planting and the other half as a side application about July 1, according to growth and season. The fertilizer mixture should contain about 10 per cent available phosphoric acid, 1½ per cent potash, and 5 per cent nitrogen; 6 per cent nitrogen is not too much on lands which have been cropped continuously in cotton, corn, and small grain.

I. Fertilizer Experiments With Corn on Piedmont Cecil Sandy Loam Soil

This is the second of a series of bulletins for the Central Farm at West Raleigh giving the results of experiments to determine the fertilizer needs of different crops on different types of soil. Other reports of field tests with different combinations and amounts of commercial fertilizer per acre have been issued, giving the results with cow peas, cotton and corn grown on the Iredell and Edgecombe test farms for a sufficient number of years in order that reliable practical deductions, with reference to the most economical fertilization of these crops may be made from the results.

WORK REPORTED.

Corn is our leading crop in this State. Although commercial fertilizers are not used very extensively in fertilizing and growing this crop yet their wise use will usually be found to pay on most Piedmont soils. These soils respond readily and profitably to proper fertilization. Some thirteen years ago systematic experiments were begun to determine the fertilizer or plant-food requirements for the most eonomical production of corn on the different soils of this State.

On the following pages are recorded the results of eight years' fertilizer tests of corn at the Experiment Station Farm for the years 1902-09 inclusive. The work is being continued to collect further data, when corn is grown as it has been in the work here recorded, as well as in rotations with other staple crops and soil improving crops.

LOCATION OF FARM AND CHARACTER OF SOIL.

This farm lies about two miles west of Raleigh and is elevated about 400 feet above sea level. The soil is made up largely of Cecil sandy loam. This is a brownish sandy clay loam about 7 to 10 inches deep, and overlying a red-clay subsoil, both of which contain from twenty to thirty per cent of medium to coarse rock fragments. The main types of soil in the Piedmont are Cecil sandy loam (gray land), red (Cecil) clay loam, and red (Cecil) clay. The clay and clay-loam types are rich in potash, very poor in phosphoric acid, and the amount of nitrogen depends on the organic matter in the soil. Analyses of samples of soil from the unfertilized plats on which these experiments were conducted, show that the soil contains on an average about the following number of pounds of plant food per acre in the surface soil (taken to a depth of 6⅔ inches, and estimated to weigh two million pounds to the acre), and in the subsoil (taken to an additional depth of 28 inches, and estimated to weigh eight million pounds per acre):

	Surface Soil 6⅔ inches	Subsoil 28 inches
Nitrogen (N)	778	2,068
Phosphoric Acid (P_2O_5)	515	4,120
Potash (K_2O)	3,041	19,172
Lime (CaO)	5,530	26,420

THE PLATS.

The plats on which these experiments were conducted were embraced in Fields A and B. These fields were badly run down when the experiments were begun in 1902. The plats in Field A were laid off in two series parallel to each other, there being sixteen plats to the series, and the plats of the two series joining directly on to each other without any driveway or turn row between the series. At the east end of the first series, and at the west end of the second series, there is an 8 or 10 foot driveway. The plats are one-twentieth acre in size and measure 132 feet long and 16½ feet wide. There is neither a row nor extra space between the plats in the different series. Field B lies immediately

south of Field A, and the plats of this field are laid out in a similar manner and are of the same size as those in Field A.

Field A. The plats of this field were used for fertilizer experiments with cotton in 1902, 1903, 1904, 1906 and 1908; and for fertilizer tests with corn in 1905, 1907 and 1909. In case of each of the two crops the same plan or system of fertilization was followed. By this is meant that plat one in all cases received nitrogen and phosphoric acid, plat two nitrogen and potash, plat three phosphoric acid and potash, and so on, though the quantities actually applied varied with the crops. The fertilization of the corn plats was based on a normal application of 300 pounds per acre of a mixture containing 7 per cent available phosphoric acid, 3 per cent nitrogen and 1½ per cent potash. The fertilization for cotton was on the basis of 400 pounds per acre of a mixture containing 7 per cent available phosphoric acid, 2½ per cent nitrogen and 2½ per cent potash.

Field B. These plats were used for fertilizer experiments with corn in 1902, 1903, 1904, 1906, and 1908; and for the experiments with cotton in 1905, 1907 and 1909. In this field the same combinations of fertilizer went on the same plats each year for the corn and cotton, but the proportions of the plant-food constituents were varied for the two crops, as was done in Field A.

PREPARATION AND CULTIVATION.

The land in all cases was well prepared by breaking with a two-horse turning plow in the winter, usually in January or February, to a depth of 8 to 10 inches and allowed to remain this way until just before planting, when it was cut up thoroughly with a disk harrow. The rows were run off 49½ inches apart, the fertilizer was distributed in the drill and covered to a slight ridge, usually with one round of a disk or other cultivator. This was done some time prior to planting, so as to give the soil time to settle before planting. Cocke's Prolific variety was used and was planted as soon as the weather would permit in the spring. The planting was done on the slight ridge made in covering the fertilizer, but this ridge was usually brought to a level, or almost to a level, by the corn planter. The corn was well cultivated with weeders, harrows, Planet, Jr., and two-horse cultivators, requiring not more than two furrows to the row, making the cultivation deep at the beginning and shallow toward the close of the season, when root development of the plants was well extended into the soil. The cultivation was repeated every ten days or two weeks during the season, the crop being laid by between July 15 and August 10, according to season. The corn was thinned to one stalk in the hill every 30 inches.

FERTILIZATION AND FERTILIZER MATERIALS USED.

As already stated, the fertilizer was applied in the drill just before planting the corn, the exact quantity of material for each row being weighed out separately so that each row would get its proper amount of the several fertilizer constituents. Acid phosphate was used as the source of phosphoric acid, except on those plats where different carriers of phosphoric acid were compared; dried blood, as the source of nitro-

gen except where there was a comparison of different nitrogen furnishing materials, or where nitrate of soda was used as a part of the nitrogen; manure salt, as the source of potash; and rock or building lime, for lime. The fertilizer materials were analyzed each year and applications were made on a basis of actual analysis, so as to give the exact quantities of nitrogen, phosphoric acid, and potash indicated for each plat. For the sake of simplicity and convenience in presenting the results of a number of years' experiments, the fertilizer applications are expressed in terms of acid phosphate, containing 16 per cent available phosphoric acid; dried blood, containing 13 per cent nitrogen; nitrate of soda, containing 14.8 per cent nitrogen; and manure salt, containing 20 per cent potash. These figures representing the average composition of the materials. The applications in the fertilizer experiments were made on basis of 300 pounds per acre for the normal plat (N P K) of a mixture containing 7 per cent available phosphoric acid, and 3 per cent nitrogen and 1½ per cent potash. Lime was applied at the rate of 500 pounds of rock or building lime, or 1,000 pounds of slaked lime per acre every four years. The fertilizer applications in the tables, in addition to being represented in terms of acid phosphate, dried blood, nitrate of soda and manure salt are also expressed in terms of the symbols N, P, K, and L, which have the following significance:

N equals nitrogen at the rate of 9 pounds to the acre, or 69.2 pounds of 13 per cent dried blood;

P equals phosphoric acid at the rate of 21 pounds per acre, or 131.2 pounds of 16 per cent acid phosphate;

K equals potash at the rate of 4½ pounds per acre or 22½ pounds of 20 per cent manure salt;

L equals lime at the rate of 500 pounds rock, or 1,000 pounds of slaked lime per acre every four years.

There are columns in the tables which show the exact weights, in pounds of phosphoric acid, nitrogen and potash, applied to each plat (but expressed on acre basis). These figures will enable anyone to use these same amounts of fertilizer constituents in other materials if desired.

The following average prices per ton, which is a fair cost of the several materials to the farmer for the period under experimentation, have been assumed for the materials used:

Acid Phosphate, 16 per cent	$14.00
Dried Blood, 13 per cent	60.00
Nitrate of Soda, 14.8 per cent	50.00
Manure Salt, 20 per cent	20.00
Rock Lime	10.00

The arrangement of the plats and the scheme of application of fertilizer is shown by the following:

Normal fertilizer application, 300 pounds per acre of mixture containing—

Phosphoric Acid	7	per cent.
Nitrogen	3	per cent.
Potash	1½	per cent.

In this normal application—

N equals 9 pounds nitrogen, equals 69.2 pounds 13 per cent dried blood;

P equals 21 pounds phosphoric acid, equals 131.2 pounds 16 per cent acid phosphate;

K equals 4½ pounds potash, equals 22½ pounds 20 per cent manure salt.

SIZE OF PLATS, ONE-TWENTIETH ACRE.

(132x16½ feet).

First Series	Application.
1	N P
2	N K
3	P K
4	O
5	N P K
6	N½ P K
7	N_2 P K
8	N_3 P K
9	N P½ K
10	N P_2 K
11	N P_3 K
12	O
13	N P K½
14	N P K_2
15	N P K_3
16	½ (N P K)

Second Series	Application	
1^2	1½ (N P K)	
2^2	2 (N P K)	
3^2	3 (N P K)	
4^2	N P K	Two applications of nitrogen: ½ as blood at planting, ½ asnitrate of soda later.
5^2	O	
6^2	N P K	Two applications of nitrogen: ½ as nitrateof soda at planting, ½ as nitrate of soda later.
7^2	N P K	Two applications of nitrogen: ½ as blood at planting, ½ as blood later.
8^2	N P K	Two sources of nitrogen: 1-5 as nitrate of soda at planting, 4-5 as blood at planting.
9^2	N P K	All nitrogen derived from cotton seed.
10^2	N P K	All nitrogen derived from stable manure.
11^2	N P K	Two applications of fertilizer: ½ at planting, ½ later.
12^2	Lime	1,000 pounds slaked lime per acre, broadcast every fourth year.
13^2	O	
14^2	N P K L	
15^2	N P K	All fertilizer applied broadcast.
16^2	N P K	Fertilizer applied deep.

The above represents the plats in Field A. In Field B they are arranged in a similar way.

WEATHER CONDITIONS DURING THE EXPERIMENTS.

Soil, seed, fertilization, cultivation and time of planting influence the crop yield. However, weather conditions, principally rainfall, is also a factor to be considered. In the table presented below will be found the monthly and annual rainfall during the years covered by the experiments, the mean monthly and annual rainfall since 1867, and the same data for the months of May to September, inclusive. During the growing months the rainfall in 1902 and 1903 was below normal, and there was an early frost in 1903, 1906 and 1907; good conditions prevailed in 1904; and in 1905 and 1908 there was more than a normal amount of rainfall. The rainfall throughout 1909 was low but for the growing season it was about normal. The year 1908 was noted for its heavy rainfalls.

RAINFALL IN INCHES AT RALEIGH.

	1902	1903	1904	1905	1906	1907	1908	1909	Means of Observations 1867–1908
January	2.39	3.04	2.80	2.37	3.67	1.23	4.26	1.90	3.12
February	7.08	6.67	4.22	6.05	3.74	4.26	3.66	3.14	4.24
March	2.14	7.32	3.55	3.39	5.35	3.38	5.58	2.77	4.19
April	3.10	5.92	0.29	5.03	0.73	3.63	2.56	4.08	3.41
May	2.00	2.67	2.76	7.76	1.73	4.75	2.03	2.92	4.57
June	3.04	4.61	6.64	1.72	4.96	6.73	6.20	5.73	4.57
July	3.39	4.41	3.48	7.65	5.35	1.42	6.14	6.84	5.43
August	2.76	3.60	5.51	7.33	8.28	2.96	13.63	4.40	6.14
September	2.92	1.43	5.23	1.43	3.29	6.13	3.70	4.52	3.71
October	3.07	5.28	2.70	2.05	2.63	0.22	3.76	1.52	3.12
November	4.12	0.88	5.13	0.66	0.69	5.29	1.47	0.11	2.42
December	3.15	2.21	3.02	6.52	2.92	7.78	3.64	1.89	3.18
Annual	39.16	48.04	45.33	51.96	43.34	47.78	56.63	39.82	48.10
Total for growing season, May to September inclusive	14.11	16.72	23.62	25.89	23.61	21.99	31.70	24.41	24.42

METHOD OF DETERMINING THE EFFECTS OF THE DIFFERENT FERTILIZER MIXTURES.

In Field A there was considerable difference between the average yields secured from the different unfertilized plats. These differences were largely due to the natural lay of the land on which the plats were laid out in this field. Plat 12 was at the top of the hill and the land sloped slightly in both directions from this plat, the greatest slope being in the direction of unfertilized plat 4. As the slope in each direction and the increase in natural productivity of the land from plat 12 seemed to be uniformly gradual, the following formula was devised and used in securing the average annual increase in yield of corn per acre on both fields where the fertilized plats had unfertilized plats on both sides of them; but where there was an unfertilized plat only on one side, the effect of the fertilizer applied to that particular plat was determined by direct subtraction from this plat of the yield of the nearest unfertilized plat in the series in the same field.

The measure of the effect of the fertilizer mixture applied to any plat is equal to the total yield on that plat decreased by the yield of the first unfertilized plat of the group, and further increased or decreased (according as the unfertilized yield decreases or increases from first to last plat of the group), by the product of the difference in the yield of the first and the last unfertilized plats of the group by the ratio of the position of the plat in the group to the whole number of plats.

For example—

Let E =True measure of the effect of fertilizer mixture applied.
T =Total yield of that plat under consideration.
A =Yield of first unfertilized plat.
B =Yield of last unfertilized plat in the group.
N_2=No. of the last plat in group.
N_1=No. of the first plat in group.
N =No. of the plat to which correction is to be applied.

Then

$$E = T - A - \frac{N - N_1}{N_2 - N_1}(B - A)$$

THE RESULTS.

In studying the yields of the two fields it is well to bear in mind that cotton was grown continuously in Field A and corn in Field B during 1902, 1903 and 1904, but after this these crops were grown in alternate years on the two fields. Since 1904, with one or two years exceptions, a leguminous crop has been seeded on each of the two fields either in the crop, as was the case with cow peas in corn some little time before last cultivation of the corn, or after the first of September when crimson or bur clover was seeded in the crops of corn and cotton growing on the two fields. None of the leguminous catch crops for the period covered in the report made sufficient growth on the different plats of the two fields to amount to much in the way of adding humus and nitrogen to the soil, largely because of the rather bad mechanical condition of the soil, which made it very difficult to secure and maintain a satisfactory stand of these catch crops on the different plats of the two fields. Since 1909 barnyard manure has been added in equal quantities to all the plats in both of the fields. The addition of a relatively small amount of manure to the different plats, the soil of which before was very deficient in organic matter, has had a rather marked effect in securing a better stand and more satisfactory growth of the catch crops grown on the plats of these two fields between the plantings of corn and cotton. From these results and other observations it would appear to be that some soils are so deficient in organic matter and have gotten into such a run-down condition generally that it would seem that one of the most practical ways to enliven them and fit them for growing leguminous cover crops would be to give them a fairly liberal coating of barnyard manure.

Until organic matter has been embodied in this soil, it tends strongly to run together after every rain and a moist condition of the soil that is favorable to germination of the seed and to the subsequent growth

of the young plants is most difficult to secure and maintain during the summer and the early fall for such leguminous crops that may be put in rotation. Cowpeas, crimson clover, bur clover and hairy vetch are examples of these crops.

In the future, as during the past three years (1911-1913), the crops will be grown according to the following rotation:

First year .....Cotton, and rye and crimson clover.
Second year .....Corn and rye.

Each crop has been and will be in the future fertilized according to the scheme outlined in the fertilizer experiments for cotton and corn.

The experiments were planned to cover the culture and fertilization of corn as a whole, but the results of the several sub-divisions or phases of the subject are grouped in short tables to facilitate examination and the drawing of conclusions. After which the experiments will be considered as a whole and general conclusions drawn for the fertilization of the crop on this type of soil.

TABLE I.—RESULTS OF FERTILIZER EXPERIMENTS WITH CORN: EFFECT OF WITH A COMPLETE

Results on Field A

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
1	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P=	9	21							
2	69 Pounds of 13% Blood—N= / 22.5 Pounds of 20% Manure Salt—K=	9		4.5						
3	131 Pounds of 16% Acid Phosphate*—P= / 22.5 Pounds of 20% Manure Salt*—K=		21	4.5						
4	Unfertilized—O=									
4	Unfertilized—O=									
*5	69 Pounds of 13% Blood*—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5						
12	Unfertilized—O=									
5[2]	Unfertilized—O=									
12[2]	500 Pounds Unslaked Lime applied every 4 years—L=									
13[2]	Unfertilized—O=									
13[2]	Unfertilized—O=									
14[2]	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K= / 500 Pounds Unslaked Lime applied every 4 years—L=	9	21	4.5						
19[2]	Unfertilized—O=									

Results in Field B

1	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P=	9	21		10.4	1230	18.3	1675	25.9	1820
2	69 Pounds of 13% Blood—N= / 22.5 Pounds of 20% Manure Salt—K=	9		4.5	9.0	1030	13.9	1165	16.5	1100
3	131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=		21	4.5	8.8	1055	20.6	1565	25.6	1880
4	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5	10.4	1282	16.8	1415	26.2	1840
5	Unfertilized—O=				4.1	676	14.1	1060	16.5	1140
4[2]	Unfertilized—O=				7.7	973	7.9	730	12.8	890
11[2]	500 Pounds of Unslaked Lime every 4 years—L=				6.2	826	8.7	700	14.7	920
12[2]	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K= / 500 Pounds of Unslaked Lime every 4 years—L=	9	21	4.5	11.4	1403	21.2	1710	33.2	1910
14[2]	Unfertilized—O=				7.9	938	8.4	825	15.4	990

NITROGEN, PHOSPHORIC ACID, POTASH AND LIME ALONE AND IN COMBINATION FERTILIZER.

IN 1905, 1907 AND 1909.

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 30 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
1	39.3	1850	----	----	15.5	1580	----	----	7.2	1620	20.7	1683	6.5	514	$ 5.20	$ 2.57	$ 7.77	$ 2.99	$ 4.78
2	26.5	1478	----	----	12.4	1100	----	----	4.6	1220	14.5	1266	0.3	97	0.24	0.49	0.73	2.30	—1.57
3	32.5	1610	----	----	11.4	1230	----	----	7.6	1375	17.2	1405	3.0	236	2.40	1.18	3.58	1.14	2.44
4	27.2	1330	----	----	11.1	976	----	----	4.3	1200	14.2	1169	----	----	----	----	----	----	----
4	27.2	1330	----	----	11.1	976	----	----	4.3	1200	14.2	1169	----	----	----	----	----	----	----
*5	31.8	1918	----	----	12.6	1005	----	----	8.7	1640	17.7	1521	4.7	418	3.76	2.09	5.85	3.21	2.64
12	10.4	710	----	----	2.7	826	----	----	0.3	400	4.5	645	----	----	----	----	----	----	----
5[2]	24.0	1170	----	----	15.6	1276	----	----	3.0	990	14.2	1145	----	----	----	----	----	----	----
12[2]	22.7	1240	----	----	13.4	1226	----	----	2.7	990	12.9	1152	2.8	263	2.24	1.32	3.56	0.63	2.93
13[2]	21.0	1250	----	----	6.9	600	----	----	0.7	710	9.5	853	----	----	----	----	----	----	----
13[2]	21.0	1250	----	----	6.9	600	----	----	0.7	710	9.5	853	----	----	----	----	----	----	----
14[2]	25.5	1710	----	----	19.2	1708	----	----	10.9	1970	18.5	1796	9.6	996	7.68	4.98	12.66	3.84	8.82
19[2]	13.1	888	----	----	4.0	510	----	----	1.0	210	6.0	536	----	----	----	----	----	----	----

IN 1902, 1903, 1904, 1906 AND 1908.

1	----	----	24.1	1530	----	----	15.4	1350	----	----	18.8	1521	9.6	727	7.63	3.64	11.32	2.99	8.33
2	----	----	13.4	820	----	----	2.9	480	----	----	11.1	919	1.9	125	1.52	0.63	2.15	2.30	—0.15
3	----	----	25.7	1350	----	----	14.2	1310	----	----	19.0	1432	9.8	638	7.84	3.19	11.03	1.14	9.89
4	----	----	22.5	1580	----	----	16.2	1475	----	----	18.4	1518	9.2	724	7.36	3.62	10.98	3.21	7.77
5	----	----	10.1	670	----	----	1.4	425	----	----	9.2	794	----	----	----	----	----	----	----
4[2]	----	----	9.3	690	----	----	1.9	395	----	----	7.9	736	----	----	----	----	----	----	----
11[2]	----	----	11.5	720	----	----	2.0	480	----	----	8.6	729	0.1	—35	0.08	—0.18	—0.10	0.63	—0.73
12[2]	----	----	24.9	1570	----	----	18.4	1240	----	----	21.8	1567	13.2	799	10.56	4.00	14.56	3.84	10.72
14[2]	----	----	10.4	700	----	----	1.7	425	----	----	8.8	776	----	----	----	----	----	----	----

Table I.—

Average Results of Eight

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
4–5	Unfertilized—O=									
1–1	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
2–2	69 Pounds of 13% Blood—N=	9								
	22.5 Pounds of 20% Manure Salt—K=			4.5						
3–3	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
(4+12)–5	Unfertilized—O=									
5–4	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
(5^2+13^2)–(4^2+14^2)	Unfertilized—O=									
12^2–11^2	500 Pounds of Unslaked Lime every 4 years—L=									
(13^2+19^2)–(4^2+14^2)	Unfertilized—O=									
14^2–12^2	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
	500 Pounds of Unslaked Lime every 4 years—L=									

*Results on these plats reversed on account of fertilizer application being reversed.

Continued.

YEARS ON FIELDS A AND B.

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
4–5	----	----	----	----	----	----	----	----	----	----	-----	-----	-----	-----	$----	$----	$----	$----	$----
1–1	----	----	----	----	----	----	----	----	----	----	19.8	1602	8.1	621	6.48	3.11	9.55	2.99	6.60
2–2	----	----	----	----	----	----	----	----	----	----	12.8	1093	1.1	111	0.88	0.56	1.44	2.30	—0.86
3–3	----	----	----	----	----	----	----	----	----	----	18.1	1419	6.4	437	5.12	2.19	7.31	1.14	6.17
(4+12)–5	----	----	----	----	----	----	----	----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----
5–4	----	----	----	----	----	----	----	----	----	----	18.1	1520	7.0	571	5.60	2.86	8.42	3.21	5.25
$(5^2+13^2)-(4^2+14^2)$																			
12^2-11^2	----	----	----	----	----	----	----	----	----	----	10.8	941	1.5	114	1.20	0.57	1.73	0.63	1.14
$(13^2+19^2)-(4^2+14^2)$	----	----	----	----	----	----	----	----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----
14^2-12^2	----	----	----	----	----	----	----	----	----	----	20.2	1682	11.4	898	9.12	4.49	13.61	3.84	9.77

EFFECT OF NITROGEN, PHOSPHORIC ACID, POTASH AND LIME IN COMBINATION.

The experiments, the results of which are presented in Table 1 were planned to show the effect on the yield of corn of nitrogen (N), phosphoric acid (P) and potash (K), when two of the constituents were applied together, as nitrogen and phosphoric acid (N P), nitrogen and potash (N K), and phosphoric acid and potash (P K) and when all three of these fertilizer constituents were applied to make a complete fertilizer (N P K); also to test the effect of lime (L) alone and when used in connection with a complete fertilizer (N P K L).

The results are shown in number of bushels of shelled corn and pounds of stover per acre for the several years, average yields, average increases over unfertilized (O) plats, which represent the effects of the fertilizer applications, the value of the increase, the cost of the fertilizer, and the value of the increased yield of corn and stover and of corn alone over cost of fertilizer. The value of the increased yield of corn and stover and of corn alone represents the profit from the several fertilizer applications after paying for the fertilizer itself.

In these experiments the corn was cut, shucked and shredded, the stover being all of the plant except the corn and the cob.

Nitrogen and Phosphoric Acid, N P (Plats 1 and 1). A combination of nitrogen and phosphoric acid increased the yields over the unfertilized plats in all eight years in the two fields, the average annual increase for the three years in Field A being 6.5 bushels of corn and 514 pounds of stover per acre; and for five years in Field B 9.6 bushels of corn and 727 pounds of stover; or an average annual increase for the eight years in the two fields of 8.1 bushels of corn and 621 pounds of stover worth $3.49 over cost of fertilizer for corn alone, or $6.60 for the increased yield of corn and stover.

Nitrogen and Potash, N K (Plats 2 and 2). There were small average increased yields of corn and stover in the two fields from the applications of a mixture of nitrogen and potash the average for the eight years in two fields being 1.1 bushels per acre of corn and 111 pounds of stover, which increase, on an average, was not sufficient to pay for the fertilizer. This fertilization was, therefore, at a loss, having cost $1.42 per acre more annually than the value of the increased yield of corn and 86 cents more than the value of the corn and stover combined.

Phosphoric Acid and Potash, P K (Plats 3 and 3). This mixture of phosphoric acid and potash gave increased yields on all the plats in the two fields. The average annual increase for three years in Field A was 3.0 bushels of corn and 236 pounds of stover per acre; and for five years in Field B 9.8 bushels of corn and 638 pounds of stover, or an average for the eight years in the two fields of 6.4 bushels of corn and 437 pounds of stover, worth $3.98 over cost of fertilizer on the basis of corn alone, or $6.17 on the basis of corn and stover.

Nitrogen, Phosphoric Acid and Potash, N K P (Plats 5 and 4). By combining all three of the fertilizer materials to make a complete fertilizer, increased yields were obtained on the two plats in the two fields. The average annual increase for three years in Field A was 4.7 bushels of corn and 418 pounds of stover per acre; and for five

years in Field B 9.2 bushels of corn and 724 pounds of stover, or an annual average increase for the eight years in the two fields of 7.0 bushels of corn and 571 pounds of stover, worth $2.39 over cost of fertilizer on basis of corn alone, or $5.25 on basis of corn and stover.

Lime, L (Plats 12^2 and 11^2). Lime was applied at the rate of 500 pounds rock or 1,000 pounds of slaked lime per acre every fourth year. On the plat in Field A during three years there was a profit of $2.93 per acre from the use of lime, counting the value of corn and stover. On the plat in Field B there was a loss of 73 cents per acre annually, the average for the eight years being a gain of $1.14 per acre.

Complete Fertilizer with Lime, N P K L (Plats 14^2 and 12^2). When lime was used in combination with the three fertilizer constituents on Field A, there was an average increase of 4.9 bushels of corn and 578 pounds of stover more from the N P K L application than from N P K. The increase was not uniform for the different years, in fact in 1905 the N P K application produced 6.3 bushels of corn and 208 pounds of stover per acre more than did the application of N P K L. The lime was applied to this field during May, 1903. The average increase in Field B from lime used with a complete fertilizer over a complete fertilizer alone was 4 bushels of corn and 75 pounds of stover per acre. The increases of shelled corn were in each year uniformly larger from the N P K L than from the N P K application.

On an average, taking the results of both fields together, there was an increase due to the lime above the cost of the lime to the value of $2.89 per acre on the basis of corn alone and of $4.52 on the basis of corn and stover together.

As an average of all the results, the experiments show:

(1) That a nitrogen and phosphoric acid mixture added decidedly to the increased yields and profits, the average annual increase being worth $6.60 per acre above the cost of the fertilizing materials;

(2) That nitrogen and potash combined increased the yield very slightly but at a loss;

(3) That on an average phosphoric acid and potash yielded 1.7 bushels of corn and 184 pounds of stover less than did the combination of phosphoric acid and nitrogen;

(4) That potash added to nitrogen and phosphoric acid resulted in a small increase in yield and without profit; and

(5) That the use of lime alone resulted practically in no profit per acre, but when used with nitrogen, phosphoric acid and potash there was a somewhat better showing made.

TABLE II.—RESULTS OF FERTILIZER EXPERIMENTS WITH CORN—

Results in Field A

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
4	Unfertilized—O=									
6	34.5 Pounds of 13% Blood—½ N= / 131 Pounds of 16% Phosphoric Acid—P= / 22.5 Pounds of 20% Manure Salt—K=	4.5	21	4.5						
*5	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5						
7	138 Pounds of 13% Blood—2 N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	18	21	4.5						
8	207 Pounds of 13% Blood—3 N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	27	21	4.5						
12	Unfertilized—O=									

Results in Field B

5	Unfertilized—O=				4.1	676	14.1	1060	16.5	1140
6	34.5 Pounds of 13% Blood—½ N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	4.5	21	4.5	9.6	1230	19.8	1665	28.2	1960
5	Unfertilized—O=				4.1	676	14.1	1060	16.5	1140
4	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5	10.4	1282	16.8	1415	26.2	1840
5	Unfertilized—O=				4.1	676	14.1	1060	16.5	1140
7	138 Pounds of 13% Blood—2 N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	18	21	4.5	10.1	1353	21.3	1685	32.7	2060
8	207 Pounds of 13% Blood—3 N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	27	21	4.5	13.0	1668	23.3	2030	36.6	2250
14	Unfertilized—O=				9.4	1130	16.9	1385	18.1	1270

EFFECTS OF VARYING QUANTITIES OF NITROGEN ON YIELD.

IN 1905, 1907 AND 1909.

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
4	27.2	1330	----	----	11.1	976	----	----	4.3	1200	14.2	1169	-----	-----	$-----	$-----	$-----	$-----	$-----
6	25.1	1550	----	----	11.5	246	----	----	6.5	1570	14.4	1122	2.6	84	2.08	0.42	2.50	2.18	0.32
*5	31.8	1918	----	----	12.6 *	1005 *	----	----	8.7	1640	17.7	1521	4.7	418	3.76	2.09	5.85	3.21	2.64
7	36.7	1985	----	----	16.6	1306	----	----	13.9	2080	22.4	1790	11.8	818	9.44	4.09	13.53	5.28	8.25
8	38.1	2050	----	----	19.1	1456	----	----	15.8	2185	24.3	1897	15.0	990	12.00	4.95	16.95	7.35	9.60
12	10.4	710	----	----	2.7	826	----	----	0.3	400	4.5	645	-----	-----	------	------	------	------	------

IN 1902, 1903, 1904, 1906 AND 1908.

5	----	----	10.1	670	----	----	1.4	425	----	----	9.2	794	-----	-----	------	------	------	------	------
6	----	----	24.3	1490	----	----	14.8	1430	----	----	19.3	1555	10.1	744	8.08	3.72	11.80	2.18	9.62
5	----	----	10.1	670	----	----	1.4	425	----	----	9.2	794	-----	-----	------	------	------	------	------
4	----	----	22.5	1580	----	----	16.2	1475	----	----	18.4	1518	9.2	724	7.36	3.62	10.98	3.21	7.77
5	----	----	10.1	670	----	----	1.4	425	----	----	9.2	794	-----	-----	------	------	------	------	------
7	----	----	28.8	1690	----	----	17.2	1645	----	----	22.0	1687	12.9	858	10.32	4.29	14.61	5.28	9.33
8	----	----	28.5	1620	----	----	21.0	1820	----	----	24.5	1878	15.4	1032	12.32	5.16	17.48	7.35	10.13
14	----	----	12.4	660	----	----	0.9	305	----	----	8.8	950	-----	-----	------	------	------	------	------

Table II.—

Average Results of Eight

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
(4+12)-(5+14)	Unfertilized.....O=									
6-6	34.5 Pounds of 13% Blood.....½ N=	4.5								
	131 Pounds of 16% Acid Phosphate.....P=		21							
	22.5 Pounds of 20% Manure Salt.....K=			4.5						
(4+12)-5	Unfertilized.....O=									
5-4	69 Pounds of 13% Blood.....N=	9								
	131 Pounds of 16% Acid Phosphate.....P=		21							
	22.5 Pounds of 20% Manure Salt.....K=			4.5						
(4+12)-(5+14)	Unfertilized.....O=									
7-7	138 Pounds of 16% Blood.....2 N=	18								
	131 Pounds of 16% Acid Phosphate.....P=		21							
	22.5 Pounds of 20% Manure Salt.....K=			4.5						
8-8	207 Pounds of 13% Blood.....3 N=	27								
	131 Pounds of 16% Acid Phosphate.....P=		21							
	22.5 Pounds of 20% Manure Salt.....K=			4.5						

*These results were taken from plat 3, as the fertilizer application with this plat and plat 5 were reversed.

EFFECT OF VARYING QUANTITIES OF NITROGEN.

The experiments, results from which are given in Table 2, were planned to test the effects on the yield of corn and stover of varying quantities of nitrogen, leaving the phosphoric acid and potash constant.

On one plat the nitrogen was reduced to one-half the normal quantity, making the application 4½ pounds per acre, or practically 2.4 per cent of nitrogen in the actual amount of the mixture used. On two of the plats it was increased by two and three times the normal quantity (9 pounds per acre), making the application 18 and 27 pounds per acre respectively, or on the four plats 4½, 9, 18 and 27 pounds of nitrogen per acre.

The average results for three years in Field A showed the largest profit to have come from the application containing three times the normal quantity of nitrogen per acre, or 27 pounds of nitrogen, the

Continued.

YEARS ON FIELDS A AND B.

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
(4+12)–(5+14)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	$----	$----	$----	$----	$----
6–6	----	----	----	----	----	----	----	----	----	----	16.9	1339	6.35	414	5.08	2.07	7.15	2.18	4.97
(4+12)–5	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
5–4	----	----	----	----	----	----	----	----	----	----	18.1	1520	6.95	571	5.56	2.86	8.42	3.21	5.21
(4+12)–(5+14)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
7–7	----	----	----	----	----	----	----	----	----	----	22.2	1739	12.35	838	9.88	4.19	14.07	5.28	8.79
8–8	----	----	----	----	----	----	----	----	----	----	24.4	1888	15.2	1011	12.16	5.06	17.22	7.35	9.87

average yield being 24.3 bushels of corn per acre, and the profit $4.65 over cost of fertilizer on the basis of corn alone or $9.60 on the basis of both corn and stover. For five years, in Field B, the largest yields and profits were also from the application containing three times the normal quantity of the nitrogen, average yield of corn being 24.5 bushels per acre, and the profit $4.97 over the cost of fertilizer, on the basis of corn alone, or $10.13 on the basis of corn and stover. Averaging the results of both fields, the gain per acre from the use of the N_3 P K applications was $4.81 on the basis of corn alone and $9.87 when both corn and stover are considered. On an average as will be seen from the results in Table 2 the yields and profits per acre increased as the amount of the nitrogen in the mixture increased.

TABLE III.—RESULTS OF FERTILIZER EXPERIMENTS WITH CORN—

Results in Field A

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
4	Unfertilized—O=									
9	69 Pounds of 13% Blood—N= 65.5 Pounds of 16% Acid Phosphate—½ P= 22.5 Pounds of 20% Manure Salt—K=	9	10.5	4.5						
*5	69 Pounds of 13% Blood—N= 131 Pounds of 16% Acid Phosphate—P= 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5						
10	69 Pounds of 13% Blood—N= 262 Pounds of 16% Acid Phosphate—2 P= 22.5 Pounds of 20% Manure Salt—K=	9	42	4.5						
11	69 Pounds of 13% Blood—N= 393 Pounds of 16% Acid Phosphate—3 P= 22.5 Pounds of 20% Manure Salt—K=	9	63	4.5						
12	Unfertilized—O=									

Results in Field B

*5	Unfertilized—O=				4.1	676	14 1	1060	16.5	1140
9	69 Pounds of 13% Blood—N= 65.5 Pounds of 16% Acid Phosphate—½ P= 22.5 Pounds of 20% Manure Salt—K=	9	10.5	4.5	11.5	1346	19.6	1545	28.7	1870
5*	Unfertilized—O=				4.1	676	14.1	1060	16.5	1140
4	69 Pounds of 13% Blood—N= 131 Pounds of 16% Acid Phosphate—P= 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5	10.4	1282	16.8	1415	26.2	1840
5*	Unfertilized—O=				4.1	676	14 1	1060	16 5	1140
10	69 Pounds of 13% Blood—N= 262 Pounds of 16% Acid Phosphate—2 P= 22.5 Pounds of 20% Manure Salt—K=	9	42	4.5	11.8	1551	22 5	2115	34 9	2270
11	69 Pounds of 13% Blood—N= 393 Pounds of 16% Acid Phosphate—3 P= 22.5 Pounds of 20% Manure Salt—K=	9	63	4.5	13.5	1600	21.6	2460	29.7	2300
14*	Unfertilized—O=				9.4	1130	16 9	1385	18.1	1270

EFFECT OF VARYING QUANTITIES OF PHOSPHORIC ACID ON YIELD.

IN 1905, 1907 AND 1909.

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
4	27.2	1330	----	----	11.1	976	----	----	4.3	1200	14.2	1169	-----	-----	$-----	$-----	$-----	$-----	$-----
9	28.1	1588	----	----	14.8	1226	----	----	8.4	1720	17.1	1511	9.0	670	7.20	3.35	10.55	2.75	7.80
*5	31.8	1918	----	----	12.6 *	1005 *	----	----	8.7	1640	17.7	1521	4.7	418	3.76	2.09	5.85	3.21	2.64
10	26.6	1733	----	----	13.4	1130	----	----	10.4	2000	16.8	1621	9.9	844	7.92	4.22	12.14	4.13	8.01
11	26.3	1780	----	----	16.6	1396	----	----	10.9	2050	17.9	1742	12.2	1032	9.76	5.16	14.92	5.05	9.87
12	10.4	710	----	----	2.7	826	----	----	0.3	400	4.5	645	-----	-----	------	------	------	------	------

IN 1902, 1903, 1904, 1906 AND 1908.

*5	----	----	10.1	670	----	----	1.4	425	----	----	9.2	794	-----	-----	------	------	------	------	------
9	----	----	23.1	1400	----	----	16.9	1385	----	----	20.0	1509	11.0	646	8.80	3.23	12.03	2.75	9.28
*5	----	----	10.1	670	----	----	1.4	425	----	----	9.2	794	-----	-----	------	------	------	------	------
4	----	----	22.5	1580	----	----	16.2	1475	----	----	18.4	1518	9.2	724	7.36	3.62	10.98	3.21	7.77
*5	----	----	10.1	670	----	----	1.4	425	----	----	9.2	794	-----	-----	------	------	------	------	------
10	----	----	27.6	1790	----	----	17.6	1735	----	----	22.9	1892	13.9	1011	11.12	5.06	16.18	4.13	12.05
11	----	----	22.8	1800	----	----	17.5	1780	----	----	21.0	1988	12.1	1090	9.68	5.45	15.13	5.05	10.08
*14	----	----	12.4	660	----	----	0.9	305	----	----	8.8	950	-----	-----	------	------	------	------	------

Table III.—

Average Results of Eight

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
4–5	Unfertilized—O=									
9–9	69 Pounds of 13% Blood—N= 65.5 Pounds of 16% Acid Phosphate—½ P= 22.5 Pounds of 20% Manure Salt—K=	9	10.5	4.5						
(4+12)–5	Unfertilized—O=									
5–4	69 Pounds of 13% Blood—N= 131 Pounds of 16% Acid Phosphate—P= 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5						
10–10	69 Pounds of 13% Blood—N= 262 Pounds of 16% Acid Phosphate—2 P= 22.5 Pounds of 20% Manure Salt—K=	9	42	4.5						
11–11	69 Pounds of 13% Blood—N= 393 Pounds of 16% Acid Phosphate—3 P= 22.5 Pounds of 20% Manure Salt—K=	9	63	4.5						
12–14	Unfertilized—O=									

*These results in 1907 were taken from plat 3 as the fertilizer application with this plat and plat 5 were reversed.

EFFECT OF VARYING QUANTITIES OF PHOSPHORIC ACID.

These experiments were planned to show the effect on the yields of corn and stover of varying quantities of phosphoric acid, the amounts of nitrogen and potash remaining constant. On one plat one-half the normal quantity of phosphoric acid was applied or an amount represented by 65.5 pounds of 16 per cent acid phosphate and equivalent to 6.7 per cent phosphoric acid in the fertilizer mixture. On two plats were applied two and three times the normal qauntities of phosphoric acid represented by 262 and 393 pounds of 16 per cent acid phosphate

Continued.

YEARS ON FIELDS A AND B.

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
4–5																			
9–9											18.6	1510	10.0	658	8.00	3.29	11.29	2.75	8.54
(4+12)–5																			
5–4											18.1	1520	6.95	571	5.56	2.86	8.42	3.21	5.21
10–10											19.9	1757	11.9	928	9.52	4.64	14.16	4.13	10.03
11–11											19.5	1865	12.15	1061	9.72	5.31	15.03	5.05	9.98
12–14																			

respectively, or 42 and 63 pounds of phosphoric acid per acre. The results in all the fields show increased yields and profits from all the different quantities of phosphoric acid. The largest increase in grain in yield on Field A was from the use of three times normal phosphoric acid with nitrogen and potash, while in Field B it was from the use of two times normal phosphoric acid. On an average of the results of both fields, there was practically no difference in the profit per acre above the cost of fertilizer from the two and three phosphoric acid applications, when the quantities of nitrogen and potash remained the same in the mixtures.

TABLE IV.—RESULTS OF FERTILIZER EXPERIMENTS WITH CORN:—

Results in Field A

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
12	Unfertilized—O=									
	69 Pounds of 13% Blood—N=	9								
13	131 Pounds of 16% Acid Phosphate—P=		21							
	11.3 Pounds of 20% Manure Salt—½ K=			2.3						
19	Unfertilized—O=									
4	Unfertilized—O=									
	69 Pounds of 13% Blood—N=	9								
*5	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
12	Unfertilized—O=									
	69 Pounds of 13% Blood—N=	9								
14	131 Pounds of 16% Acid Phosphate—P=		21							
	45 Pounds of 20% Manure Salt—2 K=			9						
	69 Pounds of 13% Blood—N=	9								
15	131 Pounds of 16% Acid Phosphate—P=		21							
	67.5 Pounds of 20% Manure Salt—3 K=			13.5						
19	Unfertilized—O=									

Results in Field B

5	Unfertilized—O=				4.1	676	14.1	1060	16.5	1140
	69 Pounds of 13% Blood—N=	9								
12	131 Pounds of 16% Acid Phosphate—P=		21		15.0	1711	19.2	1885	28.5	2040
	11.3 Pounds of 20% Manure Salt—½ K=			2.3						
5	Unfertilized—O=				4.1	676	14.1	1060	16.5	1140
	69 Pounds of 13% Blood—N=	9								
4	131 Pounds of 16% Acid Phosphate—P=		21		10.4	1282	16.8	1415	26.2	1840
	22.5 Pounds of 20% Manure Salt—K=			4.5						
	69 Pounds of 13% Blood—N=	9								
13	131 Pounds of 16% Acid Phosphate—P=		21		14.2	1741	23.0	2095	32.4	2200
	45 Pounds of 20% Manure Salt—2 K=			9						
14	Unfertilized—O=				9.4	1130	16.9	1385	18.1	1270
	69 Pounds of 13% Blood—N=	9								
15	131 Pounds of 16% Acid Phosphate—P=		21		10.6	1654	20.5	1970	29.3	2150
	67.5 Pounds of 20% Manure Salt—3 K=			13.5						
14	Unfertilized—O=				9.4	1130	16.9	1385	18.1	1270

EFFECT OF VARYING QUANTITIES OF POTASH ON YIELD.

IN 1905, 1907 AND 1909.

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
12	10.4	710	----	----	2.7	826	----	----	0.3	400	4.5	645	-----	-----	$-----	$-----	$-----	$-----	$-----
13	27.3	1728	----	----	15.7	1860	----	----	11.5	1845	18.2	1811	13.0	1157	10.40	5.79	16.19	3.10	13.09
19	18.8	1133	----	----	7.8	436	----	----	1.2	560	9.3	710	-----	-----	------	------	------	------	------
4	27.2	1330	----	----	11.1	976	----	----	4.3	1200	14.2	1169	-----	-----	------	------	------	------	------
*5	31.8	1918	----	----	12.6 *	1005 *	----	----	8.7	1640	17.7	1521	4.7	418	3.76	2.09	5.85	3.21	2.64
12	10.4	710	----	----	2.7	826	----	----	0.3	400	4.5	645	-----	-----	------	------	------	------	------
14	24.3	1718	----	----	13.1	950	----	----	10.4	1760	15.9	1476	10.0	812	8.00	4.06	12.06	3.44	8.62
15	21.4	1545	----	----	14.3	1360	----	----	8.1	1680	14.6	1528	8.0	855	6.40	4.28	10.68	3.66	7.02
19	18.8	1133	----	----	7.8	436	----	----	1.2	560	9.3	710	-----	-----	------	------	-----	------	------

IN 1902, 1903 1904, 1906 AND 1908

5	----	----	10.1	670	----	----	1.4	425	----	----	9.2	794	-----	-----	------	------	------	------	------
12	----	----	23.5	1500	----	----	14.6	1450	----	----	20.2	1717	11.3	802	9.04	4.01	13.05	3.10	9.95
5	----	----	10.1	670	----	----	1.4	425	----	----	9.2	794	-----	-----	------	------	------	------	------
4	----	----	22.5	1580	----	----	16.2	1475	----	----	18.4	1518	9.2	724	7.36	3.62	10.98	3.21	7.77
13	----	----	24.0	1650	----	----	15.0	1380	----	----	21.7	1813	12.9	880	10.32	4.40	14.72	3.44	11.28
14	----	----	12.4	660	----	----	0.9	305	----	----	8.8	950	-----	-----	------	------	------	------	------
15	----	----	20.9	1520	----	----	14.6	1365	----	----	19.2	1732	10.4	782	8.32	3.91	12.23	3.66	8.57
14	----	----	12.4	660	----	----	0.9	305	----	----	8.8	950	-----	-----	------	------	------	------	------

Table IV.—

Average Results of Eight

Number of Plat	Fertilizer Application Per Acre	Pounds o Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
(12+19)–(5+14) 13–12	Unfertilized—O=									
	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	11.3 Pounds of 20% Manure Salt—½ K=			2.3						
(4+12)–5 5–4	Unfertilized—O=									
	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
(12+19)–(5+14) 14–13	Unfertilized—O=									
	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	4.5 Pounds of 20% Manure Salt—2 K=			9						
(12+19)–14 15–15	Unfertilized—O=									
	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	67.5 Pounds of 20% Manure Salt—3 K=			13.5						

*These results in 1907 were taken from plat 3 as the fertilizer application with this plat and plat 5 were rereversed.

EFFECT OF DIFFERENT QUANTITIES OF POTASH.

The experiments reported in Table 4 were arranged to show the effect on the yield of corn and stover of varying quantities of potash, the amounts of nitrogen and phosphoric acid remaining constant. On one plat only one-half the normal quantity of potash was applied or 1.1 per cent in the fertilizer mixture, or 2.25 pounds of potash per acre. On two other plats two and three times the normal quantities were given, or 9 and 13.5 pounds per acre respectively. This would make the application of potash on the several plats 2.25, 4.5, 9 and 13.5 pounds. The results on an average show that the most profitable application is one containing one-half normal potash with normal quantities of nitrogen and phosphoric acid.

The indications are that 1½ per cent of potash is all that is needed for corn in this soil when used in connection with the regular quantities of nitrogen and phosphoric acid in the normal corn mixture.

Continued.

YEARS ON FIELDS A AND B.

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
(12+19)-(5+14)															$	$	$	$	$
13-12											19.2	1764	12.15	980	9.72	4.90	14.62	3.10	11.52
(4+12)-5																			
5-4											18.1	1520	6.95	571	5.56	2.86	8.42	3.21	5.21
(12+19)-(5+14)																			
14-13											18.8	1645	11.45	846	9.16	4.23	13.39	3.44	9.95
(12+19)-14																			
15-15											16.9	1630	9.2	819	7.36	4.10	11.46	3.66	7.80

TABLE V.—RESULTS OF FERTILIZER EXPERIMENTS WITH CORN:

Results on Field A

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
12	Unfertilized—O=									
16	34.5 Pounds of 13% Blood—½ N=	4.5								
	65.5 Pounds of 16% Acid Phosphate—½ P=		10.5							
	11.3 Pounds of 20% Manure Salt—½ K=			2.3						
19	Unfertilized—O=									
4	Unfertilized—O=									
*5	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
12	Unfertilized—O=									
5[2]	Unfertilized—O=									
1[2]	103.5 Pounds of 13% Blood—1½ N=	13.5								
	196.5 Pounds of 16% Acid Phosphate—1½ P=		31.5							
	33.8 Pounds of 20% Manure Salt—1½ K=			6.8						
2[2]	138 Pounds of 13% Blood—2 N=	18								
	262 Pounds of 16% Acid Phosphate—2 P=		42							
	45 Pounds of 20% Manure Salt—2 K=			9						
3[2]	207 Pounds of 13% Blood—3 N=	27								
	393 Pounds of 16% Acid Phosphate—3 P=		63							
	67.5 Pounds of 20% Manure Salt—3 K=			13.5						

Results on Field B

14	Unfertilized—O=				9.4	1130	16.9	1385	18.1	1270
16	34.5 Pounds of 13% Blood—½ N=	4.5								
	65.5 Pounds of 16% Acid Phosphate—½ P=		10.5		10.7	1424	16.8	1485	26.5	1800
	11.3 Pounds of 20% Manure Salt—½ K=			2.3						
5	Unfertilized—O=				4.1	676	14.1	1060	16.5	1140
4	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21		10.4	1282	16.8	1415	26.2	1840
	22.5 Pounds of 20% Manure Salt—K=			4.5						
14	Unfertilized—O=				9.4	1130	16.9	1385	18.1	1270
17	103.5 Pounds of 13% Blood—1½ N=	13.5								
	196.5 Pounds of 16% Acid Phosphate—1½ P=		31.5		15.0	1907	22.2	2065	35.6	2260
	33.8 Pounds of 20% Manure Salt—1½ K=			6.8						
1[2]	138 Pounds of 13% Blood—2 N=	18								
	262 Pounds of 16% Acid Phosphate—2 P=		42		10.6	1761	19.1	2090	30.2	2030
	45 Pounds of 20% Manure Salt—2 K=			9						
2[2]	207 Pounds of 13% Blood—3 N=	27								
	393 Pounds of 16% Acid Phosphate—3 P=		63		9.1	1934	21.0	2290	29.6	2250
	67.5 Pounds of 20% Manure Salt—3 K=			13.5						
4[2]	Unfertilized—O=				7.7	973	7.9	730	12.8	890

EFFECT OF VARYING QUANTITIES OF FERTILIZER ON YIELD.

IN 1905, 1907 AND 1909.

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
12	10.4	710	----	----	2.7	826	----	----	0.3	400	4.5	645	-----	-----	$-----	$-----	$-----	$-----	$-----
16	23.4	1470	----	----	13.0	1346	----	----	10.4	1840	15.6	1518	8.4	836	6.72	4.18	10.90	1.61	9.29
19	18.8	1133	----	----	7.8	436	----	----	1.2	560	9.3	710	-----	-----	-----	-----	-----	-----	-----
4	27.2	1330	----	----	11.1	976	----	----	4.3	1200	14.2	1169	-----	-----	-----	-----	-----	-----	-----
*5	31.8	1918	----	----	12.6 *	1005 *	----	----	8.7	1640	17.7	1521	4.7	418	3.76	2.09	5.85	3.21	2.64
12	10.4	710	----	----	2.7	826	----	----	0.3	400	4.5	645	-----	-----	-----	-----	-----	-----	-----
5[2]	24.0	1170	----	----	15.6	1276	----	----	3.0	990	14.2	1145	-----	-----	-----	-----	-----	-----	-----
1[2]	31.0	1790	----	----	13.9	1496	----	----	12.3	2030	19.1	1772	4.9	627	3.92	3.14	7.06	4.82	2.24
2[2]	34.8	1943	----	----	16.1	1730	----	----	14.0	2350	21.6	2008	7.4	863	5.92	4.32	10.24	6.42	3.82
3[2]	39.3	2040	----	----	15.2	1596	----	----	18.1	2430	24.2	2022	10.0	877	8.00	4.39	12.39	9.64	2.75

IN 1902, 1903, 1904, 1906 AND 1908.

14	----	----	12.4	660	----	----	0.9	305	----	----	8.8	950	-----	-----	-----	-----	-----	-----	-----
16	----	----	13.7	1250	----	----	12.2	1095	----	----	16.0	1411	7.2	461	5.76	2.31	8.07	1.61	6.46
5	----	----	10.1	670	----	----	1.4	425	----	----	9.2	794	-----	-----	-----	-----	-----	-----	-----
4	----	----	22.5	1580	----	----	16.2	1475	----	----	18.4	1518	9.2	724	7.36	3.62	10.98	3.21	7.77
14	----	----	12.4	660	----	----	0.9	305	----	----	8.8	950	-----	-----	-----	-----	-----	-----	-----
17	----	----	27.7	1720	----	----	16.9	1505	----	----	23.5	1891	14.7	941	11.76	4.70	16.46	4.82	11.64
1[2]	----	----	25.0	1760	----	----	16.4	1780	----	----	20.3	1884	12.3	1148	9.84	5.74	15.58	6.42	9.16
2[2]	----	----	33.3	2160	----	----	18.0	1770	----	----	22.2	2031	14.3	1345	11.44	6.73	18.17	9.64	8.53
4[2]	----	----	9.3	690	----	----	1.9	395	----	----	7.9	736	-----	-----	-----	-----	-----	-----	-----

Table V.—

Average Results of Eight

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
(12+19)-14	Unfertilized—O=									
16-16	34.5 Pounds of 13% Blood—½ N=	4.5								
	65.5 Pounds of 16% Acid Phosphate—½ P=		10.5							
	11.3 Pounds of 20% Manure Salt—½ K=			2.3						
(4+12)-5	Unfertilized—O=									
5-4	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
5^2-14	Unfertilized—O=									
1^2-17	103.5 Pounds of 13% Blood—1½ N=	13.5								
	196.5 Pounds of 16% Acid Phosphate—1½ P=		31.5							
	33.8 Pounds of 20% Manure Salt—1½K=			6.8						
5^2-4^2	Unfertilized—O=									
2^2-1^2	138 Pounds of 13% Blood—2 N=	18								
	262 Pounds of 16% Acid Phosphate—2 P=		42							
	45 Pounds of 20% Manure Salt—2 K=			9						
3^2-2^2	207 Pounds of 13% Blood—3 N=	27								
	393 Pounds of 16% Acid Phosphate—3 P=		63							
	67.5 Pounds of 20% Manure Salt—3 K=			13.5						

*These results in 1907 were taken from plat 3 as the fertilizer application with this plat and plat 5 were reversed.

EFFECT OF VARYING QUANTITIES OF FERTILIZER ON YIELDS.

These tests results from which are tabulated in Table 5, show the effect of increasing and decreasing the normal fertilizer application on yields, the normal (N P K) being 300 pounds of a mixture containing 7 per cent phosphoric acid, 3 per cent nitrogen and 1½ per cent potash. The applications were at the rate of 150 pounds per acre (½ N P K); 300 pounds per acre (N P K); 450 pounds per acre (1½ N P K); 600 pounds per acre (2 N P K), and 900 pounds per acre (3 N P K). The results in all the fields show increased yields and profits for all the quantities of fertilizer. The average results of the two fields taken together show that 150 pounds per acre is the most profitable quantity of the fertilizer mixture to use for corn.

Continued.

YEARS ON FIELDS A AND B.

Number of Plot	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
(12+19)–14																			
16–16											15.8	1465	7.8	649	6.24	3.25	9.49	1.61	7.88
(4+12)–5																			
5–4											18.1	1520	6.95	571	5.56	2.86	8.42	3.21	5.21
5^2–14																			
1^2–17											21.3	1832	9.8	784	7.84	3.92	11.76	4.82	6.94
5^2–4^2																			
2^2–1^2											21.0	1946	9.85	1006	7.88	5.03	12.91	6.42	6.49
3^2–2^2											23.2	2052	12.15	1111	9.72	5.56	15.28	9.64	5.64

Concisely, the average results for eight years' experiments on the two fields with varying quantities of fertilizer are as follows:

Pounds Fertilizer Per Acre	Average Yield Per Acre		Average Increase Over Unfertilized Plats Per Acre		Average Value of Increase Over Cost of Fertilizer	
	Corn, Bushels	Stover, Pounds	Corn, Bushels	Stover, Pounds	Corn	Stover
150	15.8	1,465	7.8	649	$ 7.88	$ 4.63
300	18.1	1,520	6.95	571	5.21	2.35
450	21.3	1,832	9.8	784	6.94	3.02
600	21.0	1,946	9.85	1006	6.49	1.46
900	23.2	2,052	12.15	1111	5.64	0.08

TABLE VI.—RESULTS OF FERTILIZER EXPERIMENTS WITH CORN—EFFECT OF

Results on Field A

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
5[2]	Unfertilized—O=									
*4[2]	34.5 Pounds of 13% Blood—½ N=	4.5								
	30.4 Pounds of 14.8% Nitrate of Soda—½ N=	4.5								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
5[2]	Unfertilized—O=									
†6[2]	60.8 Pounds of 14.8% Nitrate of Soda—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
‡7[2]	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
¶8[2]	55.2 Pounds of 13% Blood—⅘ N=	7.2								
	12.2 Pounds of 14.8% Nitrate of Soda—⅕ N=	1.8								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
(1) 9[2]	290.3 Pounds of Cotton Seed—N=	9	3.8	3.5						
	107.5 Pounds of 16% Acid Phosphate—P=		17.2							
	5 Pounds of 20% Manure Salt—K=			1.0						
(2) 10[2]	1800 Pounds of Stable Manure—N=	9	5.4	7.2						
	97.5 Pounds of 16% Acid Phosphate—P=		15.6							
	0 Pounds of 20% Manure Salt—K=			0						
13[2]	Unfertilized—O=									
4	Unfertilized—O=									
(3) 5	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
12	Unfertilized—O=									

Results in Field B

4[2]	Unfertilized—O=				7.7	973	7.9	730	12.8	890
*3[2]	34.5 Pounds of 13% Blood—½ N=	4.5								
	30.4 Pounds of 14.8% Nitrate of Soda—½ N=	4.5			10.4	1354	19.0	1665	30.9	2180
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
4[2]	Unfertilized—O=				7.7	973	7.9	730	12.8	890
†5[2]	60.8 Pounds of 14.8% Nitrate of Soda—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21		9.5	1247	18.6	1670	27.4	1920
	22.5 Pounds of 20% Manure Salt—K=			4.5						
‡6[2]	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21		8.6	1390	15.5	1415	23.1	1630
	22.5 Pounds of 20% Manure Salt—K=			4.5						
¶7[2]	55.2 Pounds of 13% Blood—⅘ N=	7.2								
	12.2 Pounds of 14.8% Nitrate of Soda—⅕ N=	1.8			8.8	1351	18.8	1645	25.7	1850
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						

DIFFERENT MATERIALS SUPPLYING NITROGEN AND TIME OF APPLICATION.

IN 1905, 1907 AND 1909.

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
5[2]	24.0	1170	----	----	15.6	1276	----	----	3.0	990	14.2	1145	-----	-----	$-----	$-----	$-----	$-----	$-----
*4[2]	32.3	1593	----	----	17.6	1320	----	----	11.3	1880	20.4	1598	6.2	453	4.96	2.27	7.23	2.94	4.29
5[2]	24.0	1170	----	----	15.6	1276	----	----	3.0	990	14.2	1145	-----	-----	------	------	------	------	------
†6[2]	37.1	1735	----	----	22.4	1666	----	----	14.6	1850	24.7	1750	11.1	642	8.88	3.21	12.09	2.66	9.43
‡7[2]	35.0	1760	----	----	19.3	1300	----	----	12.9	1870	22.4	1643	9.4	571	7.52	2.86	10.38	3.21	7.17
¶8[2]	32.7	1718	----	----	18.8	1636	----	----	11.6	2000	21.0	1785	8.6	750	6.88	3.75	10.63	3.10	7.53
(1) 9[2]	29.6	1470	----	----	17.8	1310	----	----	11.9	1860	19.8	1547	8.0	548	6.40	2.74	9.14	4.29	4.85
(2) 10[2]	30.5	1655	----	----	19.0	1626	----	----	11.1	1890	20.2	1724	8.9	762	7.12	3.81	10.93	2.48	8.45
13[2]	21.0	1250	----	----	6.9	600	----	----	0.7	710	9.5	853	-----	-----	------	------	------	------	------
4	27.2	1330	----	----	11.1	976	----	----	4.3	1200	14.2	1169	-----	-----	------	------	------	------	------
(3) 5	31.8	1918	----	----	12.6	1005	----	----	8.7	1640	17.7	1521	4.7	418	3.76	2.09	5.85	3.21	2.64
12	10.4	710	----	----	2.7	826	----	----	0.3	400	4.5	645	-----	-----	------	------	------	------	------

IN 1902, 1903, 1904, 1906 AND 1908.

4[2]	----	----	9.3	690	----	----	1.9	395	----	----	7.9	736	-----	-----	------	------	------	------	------
*3[2]	----	----	24.0	1500	----	----	14.7	1360	----	----	19.8	1612	11.9	876	9.52	4.38	13.90	2.94	10.96
4[2]	----	----	9.3	690	----	----	1.9	395	----	----	7.9	736	-----	-----	------	------	------	------	------
†5[2]	----	----	23.5	1460	----	----	13.7	1325	----	----	18.5	1524	10.5	784	8.40	3.92	12.32	2.66	9.66
‡6[2]	----	----	21.7	1420	----	----	13.2	1360	----	----	16.4	1443	8.3	699	6.64	3.50	10.14	3.21	6.93
¶7[2]	----	----	22.7	1560	----	----	16.5	1430	----	----	18.5	1567	10.3	819	8.24	4.10	12.34	3.10	9.24

Table VI.—Results

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
(1) 8[2]	290.3 Pounds of Cotton Seed—N=	9	3.8	3.5	9.9	1211	17.9	1510	23.9	1695
	107.5 Pounds of 16% Acid Phosphate—P=		17.2							
	5 Pounds of 20% Manure Salt—K=			1.0						
(2) 9[2]	1800 Pounds of Stable Manure—N=	9	5.4	7.2	10.3	1312	20.4	1715	27.8	2116
	97.5 Pounds of 16% Acid Phosphate—P=		15.6							
	0 Pounds of 20% Manure Salt—K=			0						
14[2]	Unfertilized—O=				7.9	938	8.4	825	15.4	990
5	Unfertilized—O=				4.1	676	14.1	1060	16.5	1140
(3) 4	69 Pounds of 13% Blood—N=	9			10.4	1282	16.8	1415	26.2	1840
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						

Average Results of Eight

5^2–4^2	Unfertilized—O=									
*4^2–3^2	34.5 Pounds of 13% Blood—½ N=	4.5								
	30.4 Pounds of 14.8% Nitrate of Soda—½ N=	4.5								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
(5^2+13^2)–(4^2+14^2)	Unfertilized—O=									
†6^2–5^2	60.8 Pounds of 14.8% Nitrate of Soda—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
‡7^2–6^2	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
¶8^2–7^2	55.2 Pounds of 13% Blood—⅘ N=	7.2								
	12.2 Pounds of 14.8% Nitrate of Soda—⅕ N=	1.8								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
(1) 9^2–8^2	290.3 Pounds of Cotton Seed—N=	9	3.8	3.5						
	107.5 Pounds of 16% Acid Phosphate—P=		17.2							
	5 Pounds of 20% Manure Salt—K=			1.0						
(2) 10^2–9^2	1800 Pounds of Stable Manure—N=	9	5.4	7.2						
	97.5 Pounds of 16% Acid Phosphate—P=		15.6							
	0 Pounds of 20% Manure Salt—K=			0						
(4+12)–5	Unfertilized—O=									
(3) 5–4	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						

*Two applications of nitrogen: One-half as blood applied with the phosphatic and potassic materials in drill at planting, and the other one-half as nitrate of soda, about July 1. In 1902 and 1903 cottonseed meal was used instead of blood and Kainit instead of manure salt on all the plats of Field B, to supply nitrogen and potash.

†Two applications of nitrogen: one-half as nitrate of soda with other materials in drill at planting and one-half as nitrate of soda about July 1.

‡Two applications of nitrogen: one-half as blood with other materials in drill at planting and one-half as blood about July 1.

IN FIELD B IN 1902, 1903, 1904, 1906 AND 1908—*Continued.*

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushel of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
(1) 8^2	----	----	20.5	1390	----	----	14.3	1365	----	----	17.3	1434	9.0	682	7.20	3.41	10.61	4.29	6.32
(2) 9^2	----	----	23.2	1460	----	----	14.7	1400	----	----	19.3	1599	11.0	843	8.80	4.22	13.02	2.48	10.54
14^2	----	----	10.4	700	----	----	1.7	425	----	----	8.8	776	----	----	----	----	----	----	----
5	----	----	10.1	670	----	----	1.4	425	----	----	9.2	794	----	----	----	----	----	----	----
(3) 4	----	----	22.5	1580	----	----	16.2	1475	----	----	18.4	1518	9.2	724	7.36	3.62	10.98	3.21	7.77
YEARS ON FIELDS A AND B.																			
5^2–4^2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
*4^2–3^2	----	----	----	----	----	----	----	----	----	----	20.1	1605	9.05	665	7.24	3.33	10.57	2.94	7.63
(5^2+13^2)–(4^2+14^2)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
†6^2–5^2	----	----	----	----	----	----	----	----	----	----	21.6	1637	10.8	713	8.64	3.57	12.21	2.66	9.55
‡7^2–6^2	----	----	----	----	----	----	----	----	----	----	19.4	1543	8.85	635	7.08	3.18	10.26	3.21	7.05
¶8^2–7^2	----	----	----	----	----	----	----	----	----	----	19.8	1676	9.45	785	7.56	3.93	11.49	3.10	8.39
(1) 9^2–8^2	----	----	----	----	----	----	----	----	----	----	18.6	1491	8.5	615	6.80	3.08	9.88	4.29	5.59
(2) $^910^2$–9^2	----	----	----	----	----	----	----	----	----	----	19.8	1662	9.95	803	7.96	4.02	11.98	2.48	9.50
(4+12)–5	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
(3) ^{8}5–4	----	----	----	----	----	----	----	----	----	----	18.1	1520	6.95	571	5.56	2.86	8.42	3.21	5.21

¶Two sources of nitrogen: one-sixth as nitrate of soda and five-sixths as blood, all applied with other materials in drill at planting.

(1) In 1907 all nitrogen supplied by cottonseed and appled with other materials in drill at planting. Part of the phosphoric acid and potash as indicated, is derived from cotton seed.

(2) All nitrogen supplied by stable manure and applied with other materals in drill at planting. Part of the phosphoric acid and potash, as indicated, is derived from the stable manure.

(3) All nitrogen supplied by blood and applied with other materials in drill at planting.

EFFECT OF DIFFERENT MATERIALS FURNISHING NITROGEN AND TIME OF APPLICATION.

The test, the results of which are presented in Table 6, were planned to determine the comparative value of dried blood and nitrate of soda as nitrogen-furnishing materials in growing corn as well as the best way to apply them.

Nitrate of soda is one of the best, if not the best, representative of quickly acting nitrogenous materials. Because of its easy solubility in water and the form of its nitrogen, it is quickly available for the use of plants. The question usually raised in connection with its use is the possibility of its loss from the soil, especially sandy or open, porous soil, because of its easy solubility in water, and of its giving out before a long growing crop has made its growth, thus leaving the crop without a supply of nitrogen before the end of the growing season. Its use is most strongly advocated for short-seasoned crops, as in early truck and vegetable growing and as a top dressing for grain and for corn and cotton after growth is well advanced, or for any crop when seen to be in need of a quickly acting nitrogen-supplying material.

Dried blood, which is a fair representative of the animal and vegetable materials furnishing nitrogen, such as tankage, cottonseed meal, etc., is not soluble in water like nitrate of soda, and hence acts more slowly and for a longer time. It must be changed into nitrate by rotting or decomposing in the soil before it can feed the crop, and is thus likely to be effective throughout a reasonable growing season.

It has become a practice in growing many crops to apply only a part of the nitrogen at the time of planting and the remaining portion later, usually as nitrate of soda, so as to keep the crop growing as rapidly as possible.

The experiments in Table 6 were planned with a view of throwing as much light as possible on these questions of nitrogen fertilization in corn growing. In the experiments, all of the phosphoric acid and potash were applied in the drill before planting. On two plats (5 and 4), all the nitrogen was supplied from dried blood; on two plats (9^2 and 8^2) nitrogen was derived from raw cotton seed; and on two plats (10^2 and 9^2) nitrogen was supplied by stable manure and applied with the phosphoric acid and potash carriers at planting time. On two plats (4^2 and 3^2) one-half the nitrogen was supplied as dried blood and was applied with phosphoric acid and potash before planting. The other half of the nitrogen was supplied as nitrate of soda and was applied about July first. On two other plats (6^2 and 5^2) all of the nitrogen was supplied by nitrate of soda, one-half being applied before planting with the phosphoric acid and potash, and the other half about July first. On still two other plats (7^2 and 6^2) the nitrogen was supplied by dried blood, one-half being applied before planting, with the phosphoric acid and potash and the other half about July first. On two more plats (8^2 and 7^2) five-sixths of the nitrogen was furnished by dried blood and one-sixth by nitrate of soda, and was all applied before planting, along with the phosphoric acid and potash.

For Field A, the results show that the most profitable application was secured by having all the nitrogen derived from nitrate of soda, using one-half of it in the drill at planting with the phosphoric acid

and potash and reserving the other half and applying it along the side of the rows about July first.

The next most profitable application for this field was stable manure used as the source of nitrogen and applied in the drill just before planting with the carriers of phosphoric acid and potash. For Field B, the greatest profit per acre above cost of fertilizer resulted first, from having one-half of the nitrogen derived from blood which was applied in the drill at planting with the phosphoric acid and potash and the other half from nitrate of soda and applied along side of the growing plants about July first; second, from having all the nitrogen derived from stable manure and applied in the drill just before planting with the carriers of phosphoric acid and potash; and third, from the same application that showed up first in Field A. The difference in the value of yields, above cost of fertilizer, between the application on this field showing the greatest profit per acre and the one coming third was but $1.30 per acre.

On neither field did cotton seed or dried blood show up as well as a nitrogen carrier for this crop on this soil in its present condition as did stable manure. Taking the results for the two fields, nitrate of soda and stable manure are slightly better carriers of nitrogen than the other carriers used. The most profitable results per acre being slightly in favor on an average, (1) by having all the nitrogen derived from nitrate of soda, applying one-half in the drill with the phosphoric acid and potash at planting, and reserving the remaining half to be applied along side the row about July first; and (2) by having all the nitrogen come from stable manure and applying, if the quantity is small, in the drill with the phosphoric acid and potash at or just before planting the corn.

It is to be borne in mind that the soil on which these tests were made is a sandy clay loam with a good clay subsoil and the danger from loss by leaching is very slight, if any. It is quite clear from eight years work on this soil with an application of 300 pounds per acre that the most economical way of applying the fertilizer is to put it all in the drill, except a portion of the nitrate of soda, before planting the crop. The results might be different on sandy loams or sandy soils.

TABLE VII.—RESULTS OF FERTILIZER EXPERIMENTS WITH CORN—

Results in Field A

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
4	Unfertilized—O=									
*5	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5						
12	Unfertilized—O=									
5[2]	Unfertilized—O=									
†11[2]	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5						
13[2]	Unfertilized—O=									
13[2]	Unfertilized—O=									
‡15[2]	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5						
¶16[2]	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5						
19[2]	Unfertilized—O=									

Results in Field B

5	Unfertilized—O=				4.1	676	14.1	1060	16.5	1140
*4	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5	10.4	1282	16.8	1415	26.2	1840
4[2]	Unfertilized—O=				7.7	973	7.9	730	12.8	890
†10[2]	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5	9.0	1109	16.5	1285	26.5	1720
‡13[2]	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5	11.7	1258	18.8	1285	25.1	1730
14[2]	Unfertilized—O=				7.9	938	8.4	825	15.4	990
14[2]	Unfertilized—O=				7.9	938	8.4	825	15.4	990
¶15[2]	69 Pounds of 13% Blood—N= / 131 Pounds of 16% Acid Phosphate—P= / 22.5 Pounds of 20% Manure Salt—K=	9	21	4.5	9.9	1332	20.6	1775	28.5	1940
23[2]	Unfertilized—O=				7.3	901	8.5	735	14.7	780

EFFECT OF DIFFERENT METHODS AND TIME OF APPLICATION.

IN 1905, 1907 AND 1909.

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
4	27.2	1330	----	----	11.1	976	----	----	4.3	1200	14.2	1169	-----	-----	$-----	$-----	$-----	$-----	$-----
*5	31.8	1918	----	----	12.6 *	1005 *	----	----	8.7	1640	17.7	1521	4.7	418	3.76	2.09	5.85	3.21	2.64
12	10.4	710	----	----	2.7	826	----	----	0.3	400	4.5	645	-----	-----	------	------	------	------	------
5[2]	24.0	1170	----	----	15.6	1276	----	----	3.0	990	14.2	1145	-----	-----	------	------	------	------	------
†11[2]	30.4	1655	----	----	17.4	1540	----	----	10.0	1910	19.3	1702	8.6	776	6.88	3.88	10.76	3.21	7.55
13[2]	21.0	1250	----	----	6.9	600	----	----	0.7	710	9.5	853	-----	-----	------	------	------	------	------
13[2]	21.0	1250	----	----	6.9	600	----	----	0.7	710	9.5	853	-----	-----	------	------	------	------	------
‡15[2]	23.2	1563	----	----	12.6	1082	----	----	7.8	1650	14.5	1432	6.2	685	4.96	3.43	8.39	3.21	5.18
¶16[2]	25.4	1655	----	----	14.5	1146	----	----	12.0	2250	17.3	1684	9.5	989	7.60	4.95	12.55	3.21	9.34
19[2]	13.1	888	----	----	4.0	510	----	----	1.0	210	6.0	536	-----	-----	------	------	------	------	------

IN 1902, 1903, 1904, 1906 AND 1908.

5	----	----	10.1	670	----	----	1.4	425	----	----	9.2	794	-----	-----	------	------	------	------	------
*4	----	----	22.5	1580	----	----	16.2	1475	----	----	18.4	1518	9.2	724	7.36	3.62	10.98	3.21	7.77
4[2]	----	----	9.3	690	----	----	1.9	395	----	----	7.9	736	-----	-----	------	------	------	------	------
†10[2]	----	----	23.1	1270	----	----	15.1	1570	----	----	18.0	1391	9.6	631	7.68	3.16	10.84	3.21	7.63
‡13[2]	----	----	22.6	1370	----	----	15.3	1175	----	----	18.7	1364	10.0	592	8.00	2.96	10.96	3.21	7.75
14[2]	----	----	10.4	700	----	----	1.7	425	----	----	8.8	776	-----	-----	------	------	------	------	------
14[2]	----	----	10.4	700	----	----	1.7	425	----	----	8.8	776	-----	-----	------	------	------	------	------
¶15[2]	----	----	22.6	1500	----	----	17.1	1910	----	----	19.7	1691	11.0	932	8.80	4.66	13.46	3.21	10.25
23[2]	----	----	7.7	400	----	----	0.8	285	----	----	7.8	620	-----	-----	------	------	------	------	------

Table VII.—

Average Result of Eight

Number of Plat	Fertilizer Application Per Acre	Pounds of Nitrogen (N) Per Acre	Pounds of Phosphoric Acid (P_2O_5) Per Acre	Pounds of Potash (K_2O) Per Acre	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre					
					1902		1903		1904	
					Corn	Stover	Corn	Stover	Corn	Stover
(4+12)–5	Unfertilized—O=									
*5–4	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
(5^2+13^2)–(4^2+14^2)	Unfertilized—O=									
†$11^2–10^2$	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
(13^2+19^2)–(4^2+14^2)	Unfertilized—O=									
‡$15^2–13^2$	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
$13^2–14^2$	Unfertilized—O=									
¶$16^2–15^2$	69 Pounds of 13% Blood—N=	9								
	131 Pounds of 16% Acid Phosphate—P=		21							
	22.5 Pounds of 20% Manure Salt—K=			4.5						
$19^2–23^2$	Unfertilized—O=									

*The fertilizer on this plat was all applied in the drill just before planting.

†The fertilizer on this plat was applied: one-half in the drill at planting, and the other one-half as a side dressing about July 1.

‡The fertilizer on this plat was applied broadcast just before planting.

¶Fertilizer on this plat was applied about three to four times as deep (4 to 5 inches) beneath the seed as ordinarily applied.

EFFECT OF DIFFERENT METHODS AND TIME OF APPLICATION OF FERTILIZER.

The results presented in Table 7 were obtained from tests planned to show the effect on the yield of corn and stover from applying—

(a) All the fertilizer in the drill before planting;

(b) Dividing the fertilizer into two equal parts, applying one-half in the drill before planting, and the other half as a side dressing about July first; and

(c) Applying all the fertilizer broadcast before planting, the quantity of fertilizer and the materials entering into it being the same in all three cases.

(d) Applying all the fertilizer about three times as deep as ordinarily applied, just before planting the corn.

Continued.

YEARS ON FIELDS A AND B.

Number of Plat	Yield in Bushels of Shelled Corn and Pounds of Stover Per Acre										Average Yield in Bushels of Corn Per Acre	Average Yield of Stover in Pounds Per Acre	Average Increase of Bushels of Corn Per Acre	Average Increase of Pounds of Stover Per Acre	Average Value of Increase of Corn at 80 Cents Per Bushel	Average Value of Increase of Stover at $10.00 Per Ton	Combined Value of Increase of Corn and Stover	Average Cost of Fertilizer Per Acre	Average Value of Increase Over Cost of Fertilizer
	1905		1906		1907		1908		1909										
	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover	Corn	Stover									
(4+12)–5	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
*5–4	----	----	----	----	----	----	----	----	----	----	18.1	1520	6.95	571	5.56	2.86	8.42	3.21	5.21
$(5^2+13^2)-(4^2+14^2)$	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
†11^2-10^2	----	----	----	----	----	----	----	----	----	----	18.7	1547	9.1	704	7.28	3.52	10.80	3.21	7.59
$(13^2+19^2)-(4^2+14^2)$	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
‡15^2-13^2	----	----	----	----	----	----	----	----	----	----	16.6	1398	8.1	639	6.48	3.20	9.68	3.21	6.47
13^2-14^2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
¶16^2-15^2	----	----	----	----	----	----	----	----	----	----	18.5	1688	10.25	961	8.20	4.81	13.01	3.21	9.80
19^2-23^2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Taking the results as a whole, the average increased yields and profits show that it has not made a very great difference whether all the fertilizer was applied in the drill before planting, or whether it was divided into two equal parts and one-half put in the drill before planting and the other half as a side dressing around July first, according to season.

It is noticeable that the deeper application, with both fields, was the most profitable method of applying the fertilizer it affording on an average 88 per cent greater profit than applying all the fertilizer in the drill at an ordinary depth at planting, and more than 51 per cent more profit than broadcasting the fertilizer application at planting time.

II. Varieties, Culture and Fertilization of Corn on Piedmont Cecil Red Clay Loam, Red Clay, and Valley Soils.

Experiments have been conducted for fourteen years with the varieties of corn on the red sandy clay loam soil of the Experiment Station Farm. These results have been given in detail in bulletins issued by the Station and by the State Department of Agriculture. On a basis of these results and other information which we have, the suggestions below are given for the culture and fertilization of corn on the red sandy clay loams, red clays, and valley soils of the Piedmont and the varieties of corn which are best suited to them.

Corn is an exhaustive crop on the soil, especially so when the stover is also removed. According to the present prices of fertilizer one bushel of corn removes from the soil about 20 cents worth of plant food. It would cost this much to return the plant food in a bushel of corn to the soil in a commercial fertilizer. A fifty-bushel yield of corn has, therefore, removed plant food to the value of about $10.

Preparation and Cultivation.—Corn delights in a thoroughly well prepared soil. The land should be broken in the fall or early spring to a depth of 6 or 8 inches and the soil may be gradually deepened beyond this to advantage. Before planting cut up the land with a disk harrow to get rid of clods and to make a good seed bed. Four feet is a good width for rows. The distance the corn is left in the row will depend on the productiveness of the land and should vary, usually, between 15 and 30 inches. The fertilizer on these soils should, as a rule be put in the drill before planting and the corn planted just below the level. Weeders and light harrows may be run across the rows two or three times before and after the corn is up and before cultivation with cultivators begin. Cultivate every ten days or two weeks with good one or two horse cultivators, which will not require more than two furrows at the greatest to the row, and as nearly as possible after rains so as to keep down grass and weeds and to conserve the supply of moisture. The cultivation should be comparatively deep early in the season, becoming shallow as the crop grows larger and its root system develops. It has been found desirable to continue the cultivation in this way until the corn is in silk and tassel, making the cultivation very shallow at last and going away some distance from the corn.

Varieties.—In the fourteen years' work on the Station Farm a very large number of varieties of corn of practically all the types generally grown have been tested. Those giving the best results are the varieties belonging to the prolific or the kind with two or more ears to the stalk. Among these, Sanders' Improved, Biggs' Seven-ear, Cocke's Prolific and Hickory King, have done especially well. The results of variety tests have been published each year in detail with summaries of results of previous years' work. These results can be had for study by any one specially interested in them.

Fertilization.—Analyses of these soils show that they are very low in phosphoric acid, fairly high in potash, and have a fair supply of lime, the quantity of nitrogen depending on the amount of vegetable or

organic matter in the soil. Experiments and analyses of the soil show that phosphoric acid is the most needed single constituent for the production of corn on these lands; nitrogen coming next and being very essential, while potash is of but little importance. It is likely not possible with present results to say just what is the best proportion of these constituents for most profitable returns, but it is certain that the fertilizer should carry a high percentage of phosphoric acid and nitrogen, and a low percentage of potash. Indications are that a mixture containing 10 to 12 per cent available phosphoric acid, 5 per cent nitrogen, and about 1½ per cent potash will give close to if not the best returns. Six per cent of nitrogen is not too much on lands which have been cropped continuously, or practically so, with corn, cotton and small grain. Five per cent nitrogen is equal to 6.08 per cent ammonia. This mixture can be used at the rate of 150 to 300 pounds per acre with good returns and profits. Larger quantities may be used with good results, but the profits, on basis of fertilizer used, will not be proportionately so large.

The nitrogen may be all derived from blood, tankage, cottonseed meal or similar products, or in part from one or all of these and in part from nitrate of soda or sulphate of ammonia. Nitrate of soda may be used as the entire source of nitrogen when divided into two parts. In fact results seem to be slightly in favor of the latter carrier.

Kainit, manure salt, sulphate or muriate of potash may furnish the potash, and acid phosphate the phosphoric acid.

One hundred and fifty pounds of the above mixture would contain 15 to 18 pounds of available phosphoric acid, 7½ pounds of nitrogen, and 2¼ pounds of potash; 300 pounds would contain 30 to 36 pounds available phosphoric acid, 15 pounds of nitrogen and 4½ pounds of potash. The required amount of phosphoric acid in 150 to 300 pounds respectively of this mixture would be supplied by 94 and 112½ pounds, and 187.5 and 225 pounds of 16 per cent acid phosphate; the nitrogen by 57.7 pounds and 115.4 pounds of 13 per cent dried blood, and the potash by 11¼ and 22½ pounds of manure salt. Other materials or other grades of these materials may be used in such quantities as may be necessary to furnish the desired amounts of plant food, having in mind that it is the specific number of pounds of phosphoric acid, nitrogen and potash that is desired rather than a given weight of mixed fertilizer.

It is probably less difficult to calculate the number of pounds of nitrogen, phosphoric acid and potash to be applied per acre to any given crop from materials which are to be had than it is to estimate the exact number of pounds of the materials to make a formula of a certain composition, as for example, in an 8-2-2 goods. The question of filler does not have to be considered in making this calculation, as it does in making a fertilizer formula in the usual way. When it is desired, for instance, to apply the equivalent of 300 pounds per acre of a fertilizer mixture containing 10 per cent available phosphoric acid, 1½ per cent potash and 5 per cent nitrogen, or 30 pounds phosphoric acid, 4½ pounds potash and 15 pounds of nitrogen, it is only neces-

sary to multiply the number of pounds of plant food desired per acre (30, 15 and 4.5) by 100 and then divide by the percentage composition of the materials to be used, as follows:

Number of Pounds of Plant Food Per Acre Wanted	÷	Percentage Composition of the Material to be Used	=	Number of Pounds Fertilizer Materials Per Acre to Apply
Phosphoric Acid, 30 lbs.	÷	16 Per cent Acid Phosphate	=	187.5
Nitrogen, 15 lbs.	÷	13 Per cent Dried Blood	=	115.4
Potash, 4½ lbs.	÷	20 Per cent Manure Salt	=	22.5

The best and most economical way to apply the fertilizer in the quantities recommended here is in the drill before planting or divide the application into two equal parts, putting one-half in the drill before planting and applying the other half as a side dressing around the first of July according to season and growth of crop. The fertilizer in the quantity here suggested should be applied in the drill.

BULLETIN 230 MARCH 1915

NORTH CAROLINA

AGRICULTURAL EXPERIMENT STATION

CONDUCTED JOINTLY BY THE

STATE DEPARTMENT OF AGRICULTURE
AND THE
COLLEGE OF AGRICULTURE AND MECHANIC ARTS

RALEIGH AND WEST RALEIGH

VARIETY TESTS OF CORN FOR 1914

THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

CONDUCTED JOINTLY BY THE

STATE DEPARTMENT OF AGRICULTURE

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L. L. Brinkley—Soil Survey
R. G. Hill—Assistant Horticulturist
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R. S. Curtis—Associate in Animal Industry
J. K. Plummer—Soil Chemist
S. C. Clapp—Assistant Entomologist
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A. R. Russell—Asst. in Field Experiments
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B. F. Kaupp,
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W. F. Pate—Agronomist—Soils
E. C. Blair—Assistant Agronomist—Soils
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[1]J. M. Johnson—Farm Management
F. R. Baker—Assistant Drainage Engineer
R. O. Cromwell—Assistant, Plant Diseases
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Stanley Combes—Assistant, Dairy Farming
F. S. Peden—Beef Cattle
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[3]J. A. Arey—Dairy Farming
[3]H. C. Ikeler—Beef Cattle
[3]J. Lloyd Brown—Beef Cattle
[3]A. G. Oliver—Poultry Clubs
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Assistant in Charge Girls' Clubs
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J. R. Mullen—Assistant Chemist
F. B. Sherwood—Assistant Chemist
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F. N. McDowell—Soil Survey
R. W. Lieby—Assistant Entomologist
Miss Mary S. Birdsong—Sec'y to Director
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R. W. Collett—Assistant Director Branch Stations
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J. H. Jefferies—Assistant Director Pender Branch Station, Willard
C. E. Clark—Assistant Director Edgecombe Branch Station, Rocky Mount
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S. O. Perkins—Assistant Director Buncombe and Transylvania Stations, Swannanoa

The members marked with * are members of the Joint Committee for Agricultural Work, and the Station is under their direction.

[1]In cooperation with the U. S. Department of Agriculture, Bureau of Plant Industry.
[2]In cooperation with the U. S. Department of Agriculture, Bureau of Soils.
[3]In cooperation with the U. S. Department of Agriculture, Bureau of Animal Industry.
[4]In cooperation with the U. S. Department of Agriculture, Office of Experiment Stations.

†Deceased.

VARIETY TESTS OF CORN FOR 1914

By G. M. Garren, Assistant in Cereal Investigations.

One hundred years ago, in 1814, there were five known varieties of corn. These were as follows, Big Yellow, Big White, Little Yellow, Little White, and Gourd Seed. The first four were of the flinty type. The fifth was of the dent type. This latter type has been cultivated in North Carolina up until recent years and can still be found in isolated instances. It is the ancestor of the present numerous varieties of dent corn. In 1840, the number of varieties had increased to forty. The varieties then were distinguished by such characteristics as color, size of ear, and density of kernel. The number of varieties has further increased to about 800 in more recent years, according to investigations by Dr. E. L. Sturtevant, the botanist.

At the present time there are no limits to the number of varieties. Then, too, the number of varieties is frequently augmented by a mere change in name of some previously established variety. Some farmer or some seedsman, wishing to put something new on the market, takes a well known variety, changes it name, usually to that of his own, and offers a new discovery to the agricultural world.

Apart from this artificial increase, there is no limit to the increase of varieties from natural causes; if every minor difference, of merit or demerit, is considered a sufficient reason for differentiating a new variety. There are no identical plants. The corn plant is especially sensitive to change of environment and possesses great adaptability. It is now grown in regions far north where 25 years ago it was thought impossible to grow it. Differences in soil fertility, in water-holding capacity of the soil, in methods and length of cultivation and in other changes of environment, produce innumerable changes in the sensitive corn plant. Under such conditions some plants or varieties may readily adjust themselves to their environment while others may fail. If deterioration is shown, the plant should be rejected for seed purposes. If improvement sufficient to be worthy of note is developed, the plant may be saved for seed purposes. The characters that add this improvement may be made permanent through inheritance by selection. When the characters become fixed, a new variety is established. If this new variety excels all other known varieties of the same plant, a real contribution has been made to agriculture.

Originating Varieties.

A farmer finds a stalk of corn in his field bearing two ears, both the stalk and ears, coming up to good corn standards. These are selected

for planting. Next year all the ears from desirable stalks, bearing two ears, are selected for seed. By the continuation of this selection for a number of years, one may produce a variety that will produce a greater number of two-eared stalks. To definitely determine whether a new variety has actually been established and has superior value, it is necessary to grow it for comparison for a number of years, the new seed along with the well known old varieties of the locality and under the same conditions. This is variety-testing, whether new varieties are being tried out or the most meritorious of the old is being sought by comparison. It is a much higher work of agriculture to propagate new varieties or to produce higher yielding strains of old ones than to simply test established varieties real or spurious. The Tables given on pages .... to .... are based on the results of variety testing during the past year. In Tables V and VI are given the summary of the results of the past year and of five previous years. From their great number it is obvious that it is a physical impossibility to test all the known varieties of corn in one season. During the past season twenty-five varieties, supposedly adapted to North Carolina conditions, have been tested at the Buncombe, the Iredell, the Central Station, and the Edgecombe Test Farms, respectively.

Results of Tests.

This season, the corn was shelled at time of husking. This interfered with obtaining mathematically accurate results especially with the late maturing varieties. It is not always possible to overcome these minor difficulties in field work. However these are eliminated in the averages for a series of years.

The tables this year, have been slightly changed from those of previous years with the hope of making them more intelligible and easy in consulting for those interested. The rank which is determined according to yield of bushels of shelled corn per acre, is placed in the first column of the tables, just before the names. The yields per acre are found in the last column under the heading "Yields per Acre and Related Data." These two columns give the rank in the test and the yield per acre of all the varieties and thereby furnish the information of most general interest.

In Table I are recorded the results of the test of the Buncombe Farm. Two one-eared varieties have taken first rank at this farm this year. First Generation Cross No. 182 which has yielded highest is a variety that has been originated and improved by the Bureau of Plant Industry of the United States Department of Agriculture. Boone County White which showed up as second best at this farm is one of the old standard varieties of one-eared corn and on account of its fine type of ear is a good exhibit corn. Unfortunately three of the varieties that have shown up well in the test heretofore were lost in husking.

In Table II are recorded the results of a test at the Iredell Farm.

Three prolific varieties take first rank at this farm as yielders, Biggs' Seven Ear coming first among the three. This variety is one of the best native prolific varieties that has been originated in the State. The other two, Goodman's Prolific and Jarvis' Golden Prolific are varieties acclimated in the vicinity of the Iredell Farm, and are of the same rank as Biggs' Seven Ear. Weekley's Improved is used for the general crop on the Iredell Farm which was the source of seed for the tests. It dropped to sixth place in the test this year, but heretofore it has been one of the best yielders at this farm.

The results of the test on the Central Farm are recorded in Table III. The corn in this test received the full effect of an unfavorable dry season. Hence the yields per acre are unusually low and the per cent of stover to the corn unusually high. The result of this illustrates the well known fact in corn growing that under unfavorable conditions, such as poor land and lack of moisture, one-eared varieties outyield prolific ones. The highest yielders in this test are First Generation Cross No. 182, Columbia Beauty and Boone County White which are one-eared varieties.

Biggs' Seven Ear which in the more normal seasons, ranked among the highest, takes fourth place under the unfavorable conditions of this year.

In Table IV are recorded the results of the test at the Edgecombe Farm. This was the most satisfactory test of the year. It was planted on a piece of land after a heavy crop of bur clover had been turned under. This enabled the varieties of corn to better withstand the severe drought of the summer. With most of the varieties, the actual stands exceeded the perfect. This is accounted for by the fact that many of the varieties suckered heavily and whenever suckers developed into stalks they were counted as such. The yields are good for this soil considering the very dry season.

In Table V will be found the compiled results of the tests with seven varieties at the Iredell Test Farm for the past six years. The yield of pounds of stover per acre and bushels of shelled corn per acre are given for each year. Then an average of these yields are given in the last two columns. The results in the compiled tables are of more value than are the results for any single year. A variety that maintains the lead over its competitors for six consecutive years may be considered one well adapted to the particular locality where the tests were conducted. A farmer residing in the upper Piedmont section wishing to select from the seven varieties listed in this table, will make no mistake in choosing Weekley's Improved, for it has proven its superiority over the other six during the six years rigid tests. It has been thoroughly acclimated to the section by being grown on the Iredell Test Farm for a number of years. Second place is held by Southern Beauty, a one-eared variety that has been acclimated and improved for several years in Forsyth County, North Carolina. Parker's Prolific and Biggs'

Seven Ear, two prolific varieties take the next place with equal rankings. Hickory King and Boone County White, two one-eared varieties, close the list.

Table VI contains the compiled results secured at the Edgecombe Farm. The arrangement of this table is the same as that of Table V and it also contains the results of six years' tests with seven varieties.

Biggs' Seven Ear leads in yield of shelled corn per acre at this farm. This is the best prolific corn for Eastern Carolina that has yet been tested on the Edgecombe Test Farm. Four prolific varieties take the first four places at this farm and three one-eared varieties the last three places. This seems an added proof that on good land prolific varieties outyield one-eared varieties.

TABLE 1.—VARIETY TEST OF CORN AT THE BUNCOMBE TEST FARM 1914.

Rank According to Yield Per Acre in Bushels of Shelled Corn	Varieties	Number of Stalks Per Plat		Average Height in Inches at Maturity		Number of Ears		Number of Stalks Bearing—				Yield Per Plat		Yield Per Acre and Related Data						Shelling Capacity			
		For Perfect Stand	By Actual Count	Stalks	Ears	Per Plat	Average Per Stalk	None	One Ear	Two Ears	Three or More Ears	Pounds of Stover	Pounds of Ears	Pounds of Stover	Pounds of Ears	Per Cent Stover	Per Cent Ears	Pounds of Ears to Shell One Bushel	Bushels of Shelled Corn	Weight of Measured Bushel of Shelled Corn	Weight of Cobs from Bushel of Shelled Corn	Per Cent Grain	Per Cent Cobs
1	First Generation Cross No. 182 (B. P. I.)	217	194	105	44	204	1.05	2	180	12	0	76	100	1900	2500	43.2	56.8	70	35.7	56	14	80.0	20.0
2	Boone County White	217	192	102	50	155	.80	37	155	0	0	50	101	1250	2525	33.2	66.8	71	35.5	57	14	80.2	19.8
3	Blount's Prolific	217	203	102	50	266	1.31	17	109	74	3	48	98	1200	2450	32.9	67.1	73	33.5	61	12	83.5	16.5
4	Goodman's Prolific	217	210	108	55	232	1.10	30	128	52	0	86	95	2150	2375	47.6	52.4	71	33.4	59	12	83.0	17.0
5	White Majestic	217	168	108	56	191	1.13	4	139	23	2	88	87	2200	2175	50.3	49.7	72	30.2	60	12	83.3	16.7
6	Parker's Prolific	217	205	102	48	189	.92	44	133	28	0	76	80	1900	2000	48.8	51.2	68	29.4	54	14	79.4	20.6
7	Weekley's Improved	217	183	108	50	203	1.10	30	104	48	1	103	88	2575	2200	54.0	46.0	77	28.5	60	17	77.9	22.1
7	Wannamaker's	217	200	114	54	205	1.02	41	113	46	0	94	88	2350	2200	51.7	48.3	77	28.5	59	18	76.6	23.4
8	Biggs' Seven Ear	217	204	108	48	324	1.58	12	87	78	27	83	87	2075	2175	48.9	51.1	77	28.2	61	16	79.2	20.8
9	Crook's Prolific	217	206	120	64	159	.77	48	157	1	0	89	81	2225	2025	52.4	47.6	72	28.1	54	18	75.0	25.0
9	Southern Snow Flake	217	158	108	52	151	.95	17	131	10	0	90	80	2250	2000	53.0	47.0	71	28.1	57	14	80.2	19.8
10	Jarvis' Golden Prolific	217	202	102	48	253	1.25	11	130	60	1	67	85	1675	2125	44.1	55.9	77	27.5	63	14	91.8	18.2
11	Shenandoah White Dent	217	185	102	48	153	.82	34	149	2	0	73	78	1825	1950	48.4	51.6	72	27.0	58	14	80.5	19.5
12	Selection No. 164 (B. P. I.)	217	185	102	55	273	1.47	21	74	71	19	82	82	2050	2050	50.0	50.0	76	26.9	61	15	80.2	19.8
13	Latham's Double	217	207	117	74	212	1.02	27	148	32	0	81	80	2025	2000	50.4	49.6	75	26.6	58	17	77.3	22.7
14	Hickory King	217	175	96	42	175	1.00	16	143	16	0	58	75	1450	1875	43.7	56.3	72	26.0	60	12	83.3	16.7
15	Deaton's Favorite	217	177	114	53	167	.94	12	163	2	0	115	69	2875	1725	62.5	37.5	68	25.3	52	16	76.4	23.6
16	Columbia Beauty	217	156	102	52	143	.91	18	133	5	0	67	73	1675	1825	47.9	52.1	74	24.6	60	14	81.0	19.0
16	Marlboro Prolific	217	185	114	54	244	1.31	11	104	70	0	79	77	1975	1925	50.7	49.3	78	24.6	62	16	79.4	20.6
17	Gerrick's Prolific (B. P. I.)	217	199	126	75	189	.94	51	107	41	0	111	67	2775	1675	62.4	37.6	76	22.0	56	20	73.6	26.4
18	Batts' Four Ears	217	197	114	51	192	.97	44	115	37	1	82	62	2050	1550	57.0	43.0	75	20.6	59	16	78.6	21.4
19	Southern Beauty	217	184	96	55	168	.91	42	116	26	0	69	57	1725	1425	54.8	45.2	70	20.3	58	12	82.8	17.2
20	Cocke's Prolific	217	185	108	51	236	1.27	18	98	69	0						Lost in Husking.						
21	Coker's One Ear	217	215	120	63	154	.71	83	111	20	1						Lost in Husking.						
22	Eureka	217	182	120	60	174	.95	39	112	31	0						Lost in Husking.						

TABLE II.—VARIETY TEST OF CORN AT THE IREDELL TEST FARM 1914.

Rank According to Yield Per Acre in Bushels of Shelled Corn	Varieties	Number of Stalks Per Plat		Average Height in Inches at Maturity		Number of Ears		Number of Stalks Bearing—				Yield Per Plat		Yield Per Acre and Related Data						Shelling Capacity			
		For Perfect Stand	By Actual Count	Stalks	Ears	Per Plat	Average Per Stalk	None	One Ear	Two Ears	Three or More Ears	Pounds of Stover	Pounds of Ears	Pounds of Stover	Pounds of Ears	Per Cent Stover	Per Cent Ears	Pounds of Ears to Shell One Bushel	Bushels of Shelled Corn	Weight of Measured Bushel of Shelled Corn	Weight of Cobs from Bushel of Shelled Corn	Per Cent Grain	Per Cent Cobs
1	Biggs' Seven Ear	181	169	108	48	274	1.62	12	43	111	3	72.0	98.0	2160	2940	42.4	57.6	73.0	40.2	60.0	13.0	82.1	17.9
2	Goodman's Prolific	181	186	108	42	225	1.20	13	121	52	0	90.0	79.0	2700	2370	53.3	46.7	65.5	36.1	57.0	8.5	87.0	13.0
2	Jarvis' Golden Prolific	181	177	90	36	237	1.33	2	113	62	0	63.5	85.0	1905	2550	42.8	57.2	70.5	36.1	59.5	11.0	84.3	15.7
3	Southern Beauty	181	158	96	48	188	1.18	4	120	34	0	63.0	74.0	1890	2220	46.0	54.0	63.5	34.9	54.0	9.5	85.0	15.0
4	Parker's Prolific	181	165	96	42	180	1.09	1	148	16	0	69.5	79.0	2085	2370	46.9	53.1	69.0	34.3	57.0	12.0	82.6	17.4
5	Cocke's Prolific	181	162	102	48	196	1.20	8	112	42	0	62.0	80.0	1860	2400	43.7	56.3	70.5	34.0	58.5	12.0	82.9	17.1
6	Weekley's Improved	181	167	96	48	230	1.37	8	89	69	1	71.0	81.0	2130	2430	46.8	53.2	72.0	33.7	57.0	15.0	79.1	20.9
7	First Generation Cross No. 182 (B. P. I.)	181	161	90	42	152	0.94	9	152	0	0	55.0	73.0	1650	2190	43.0	57.0	65.0	33.6	54.0	11.0	83.0	17.0
8	Blount's Prolific	181	180	96	36	213	1.18	12	124	43	1	58.5	79.0	1755	2370	42.6	57.4	71.5	33.1	59.5	12.0	83.2	16.8
9	Gerrick's Prolific (B. P. I.)	181	173	108	66	272	1.57	28	22	119	4	115.0	77.0	3450	2310	59.9	40.1	70.0	33.0	55.0	15.0	78.5	21.5
10	Latham's Double	181	163	114	60	213	1.30	0	113	50	0	115.0	73.0	3450	2190	61.2	38.8	67.0	32.6	56.0	11.0	83.5	16.5
11	Marlboro Prolific	181	162	96	50	232	1.43	2	89	70	1	78.5	75.0	2355	2250	51.2	48.8	71.5	31.4	57.5	14.0	80.4	19.6
12	Crook's Prolific	181	162	108	60	141	0.87	21	141	0	0	61.0	73.0	1830	2190	45.6	54.4	70.5	31.0	52.5	18.0	74.4	25.6
13	Batts' Four Ear	181	168	102	48	237	1.41	4	100	55	9	79.0	73.0	2370	2190	52.0	48.0	72.5	30.2	58.5	14.0	80.6	19.4
14	Selection No. 164 (B. P. I.)	181	158	96	48	229	1.44	10	68	79	1	58.0	72.5	1740	2175	44.5	55.5	73.0	29.7	60.0	13.0	82.1	17.9
15	Coker's One Ear	181	157	105	67	179	1.14	10	115	32	0	85.0	60.0	2550	1800	58.7	41.3	65.0	27.6	53.0	12.0	81.5	18.5
16	Hickory King	181	159	84	41	152	0.95	9	148	2	0	48.0	56.5	1440	1695	46.0	54.0	64.5	26.2	55.0	9.5	85.2	14.8
17	Eureka	181	180	90	45	172	0.95	22	144	14	0	88.0	61.0	2640	1830	59.1	40.9	74.0	24.7	56.5	17.5	76.3	23.7
18	White Majestic	181	139	96	42	141	1.01	5	127	7	0	66.0	54.0	1980	1620	55.0	45.0	67.0	24.1	57.0	10.0	85.0	15.0
19	Columbia Beauty	181	135	90	48	126	0.93	11	122	2	0	53.0	50.0	1590	1500	51.5	48.5	66.0	22.7	54.5	11.5	82.5	17.5
20	Deaton's Favorite	181	151	96	48	136	0.90	15	136	0	0	72.0	51.0	2160	1530	58.6	41.4	68.0	22.5	56.0	12.0	82.3	17.7
21	Wannamaker	181	173	102	60	231	1.33	15	85	73	0	96.0	55.0	2880	1650	63.6	36.4	75.0	22.0	58.0	17.0	77.3	22.7
22	Southern Snow Flake	181	137	89	48	125	0.91	18	113	6	0	66.0	50.0	1980	1500	56.9	43.1	69.0	21.7	56.0	13.0	81.1	18.9
23	Boone County White	181	110	102	43	105	0.95	9	97	4	0	43.0	46.0	1290	1380	48.4	51.6	66.0	20.9	53.0	13.0	80.3	19.7
24	Shenandoah White Dent	181	124	99	48	119	0.95	7	115	2	0	44.0	46.0	1320	1380	48.9	51.1	69.0	20.0	56.0	13.0	81.1	18.9

TABLE III.—VARIETY TEST OF CORN AT THE CENTRAL STATION 1914.

Rank According to Yield Per Acre in Bushels of Shelled Corn	Varieties	Number of Stalks Per Plat		Average Height in Inches at Maturity		Number of Ears		Number of Stalks Bearing—				Yield Per Plat		Yield Per Acre and Related Data						Shelling Capacity			
		For Perfect Stand	By Actual Count	Stalks	Ears	Per Plat	Average Per Stalk	None	One Ear	Two Ears	Three or More Ears	Pounds of Stover	Pounds of Ears	Pounds of Stover	Pounds of Ears	Per Cent Stover	Per Cent Ears	Pounds of Ears to Shell Measured Bushel	Bushels of Shelled Corn	Weight of Measured Bushel of Shelled Corn	Weight of Cobs from Bushel of Shelled Corn	Per Cent Grain	Per Cent Cobs
1	First Generation Cross No. 182 (B. P. I.)	132	127	102	60	98	.77	29	98	0	0	52.0	36.0	2080	1440	59.1	40.9	68	21.1	56	12	82.3	17.7
2	Columbia Beauty	132	129	98	48	68	.52	61	68	0	0	42.0	30.0	1680	1200	58.4	41.6	67	17.9	57	10	85.0	15.0
3	Boone County White	132	114	95	33	76	.66	39	74	1	0	50.0	26.0	2000	1040	65.8	34.2	59	17.6	47	12	79.6	20.4
4	Biggs' Seven Ear	132	133	96	48	127	.95	25	89	19	0	59.0	29.0	2360	1160	67.1	32.9	69	16.8	56	13	81.1	18.9
5	Hickory King	132	136	96	42	97	.71	42	91	3	0	44.0	25.0	1760	1000	63.8	36.2	70	14.2	58	12	82.8	17.2
6	White Majestic	132	125	96	45	92	.73	33	92	0	0	58.0	24.0	2320	960	70.7	29.3	68	14.1	55	13	80.8	19.2
7	Jarvis' Golden Prolific	132	143	81	33	96	.67	50	90	3	0	47.0	23.0	1880	920	67.2	32.8	68	13.5	55	13	80.8	19.2
8	Blount's Prolific	132	126	91	42	104	.82	34	80	12	0	48.0	23.0	1920	920	67.7	32.3	69	13.3	56	13	81.1	18.9
8	Cocke's Prolific	132	124	93	51	96	.77	38	76	10	0	56.0	24.0	2240	960	70.0	30.0	72	13.3	57	15	79.1	20.9
8	Southern Beauty	132	130	81	39	87	.66	45	83	2	0	48.0	23.0	1920	920	67.7	32.3	69	13.3	56	13	81.1	18.9
9	Parker's Prolific	132	138	88	39	88	.63	50	88	0	0	56.0	24.0	2240	960	70.0	30.0	73	13.1	58	15	79.4	20.6
9	Shenandoah White Dent	132	117	108	45	81	.69	37	79	1	0	37.0	23.0	1480	920	61.7	38.3	70	13.1	57	13	81.4	18.6
10	Selection No. 164 (B. P. I.)	132	139	90	45	87	.62	56	79	4	0	54.0	22.0	2160	880	71.1	28.9	71	12.3	58	13	81.6	18.4
11	Weekley's Improved	132	131	94	45	83	.63	53	73	5	0	50.0	21.0	2000	840	70.5	29.5	70	12.0	56	14	80.0	20.0
12	Deaton's Favorite	132	126	102	51	61	.48	66	59	1	0	49.0	19.0	1960	760	72.1	27.9	69	11.0	57	12	82.6	17.4
13	Southern Snow Flake	132	120	100	42	67	.55	53	67	0	0	55.0	18.0	2200	720	75.4	24.6	67	10.7	55	12	82.0	18.0
14	Crook's Prolific	132	131	96	45	56	.42	75	56	0	0	72.0	16.0	2880	640	81.9	18.1	62	10.3	52	10	83.8	16.2
15	Marlboro Prolific	132	135	90	48	77	.57	60	73	2	0	63.0	15.0	2520	600	80.8	19.2	61	9.8	50	11	81.9	18.1
16	Wannamaker	132	134	94	54	80	.59	62	64	8	0	61.0	16.0	2440	640	79.3	20.7	70	9.1	58	12	82.8	17.2
17	Batts' Four Ear	132	123	96	42	92	.74	34	86	3	0	59.5	15.5	2380	620	79.4	20.6	70	8.8	57	13	81.4	18.6
18	Goodman's Prolific	132	130	92	45	74	.56	56	74	0	0	54.0	14.0	2160	560	79.5	20.5	68	8.2	57	11	83.8	16.2
18	Latham's Double	132	126	90	48	74	.58	52	74	0	0	60.0	15.0	2400	600	80.0	20.0	73	8.2	58	15	79.4	20.6
19	Gerrick's Prolific (B. P. I.)	132	138	96	62	93	.67	54	75	9	0	72.5	12.5	2900	500	85.3	14.7	69	7.2	57	12	82.6	17.4
20	Eureka	132	124	99	57	47	.37	79	43	2	0	56.0	12.0	2240	480	82.4	17.6	70	6.8	55	15	78.5	21.5
21	Coker's One Ear	132	138	95	60	62	.44	78	58	2	0	59.0	11.0	2360	440	84.3	15.7	69	6.3	55	14	79.7	20.3

TABLE IV.—VARIETY TEST OF CORN AT THE EDGECOMBE TEST FARM 1914.

Rank According to Yield Per Acre in Bushels of Shelled Corn	Varieties	Number of Stalks Per Plat		Average Height in Inches at Maturity	Number of Ears	Number of Stalks Bearing—				Yield Per Plat		Yield Per Acre and Related Data						Shelling Capacity			
		For Perfect Stand	By Actual Count	Stalks	Ears	Per Plat	Average Per Stalk	None	One Ear	Two Ears	Three or More Ears	Pounds of Stover	Pounds of Ears	Pounds of Stover	Pounds of Ears	Per Cent Stover	Per Cent Ears	Pounds of Ears to Shell One Bushel	Bushels of Shelled Corn	Weight of Measured Bushel of Shelled Corn	Weight of Cobs from Measured Bushel of Shelled Corn	Per Cent Grain	Per Cent Cobs
1	First Generation Cross No. 182 (B. P. I.)	272	284	108	42	267	.94	20	261	3	0	151.0	138.0	3020	2760	52.3	47.7	68	40.5	56	12	82.3	17.7
2	Biggs' Seven Ear	272	290	124	54	449	1.54	10	130	131	19	151.5	145.5	3030	2910	51.1	48.9	73	39.8	60	13	82.1	17.9
3	Eureka	272	295	120	66	345	1.16	28	189	78	0	244.0	136.0	4880	2720	64.3	35.7	70	38.8	56	14	80.0	20.0
4	Columbia Beauty	272	279	120	48	265	.94	45	203	31	0	206.0	115.0	4120	2300	64.2	35.8	61	37.7	52	9	85.2	14.8
5	Crook's Prolific	272	288	120	54	256	.88	52	216	20	0	205.0	128.0	4100	2560	61.6	38.4	68	37.6	53	15	77.9	22.1
5	Weekley's Improved	272	294	114	53	420	1.42	39	101	143	11	259.5	135.5	5190	2710	65.7	34.3	72	37.6	58	14	80.5	19.5
6	Marlboro Prolific	272	294	111	60	434	1.46	28	101	162	3	230.0	135.0	4600	2700	63.1	36.9	74	36.4	60	14	81.0	19.0
7	Goodman's Prolific	272	270	120	66	398	1.47	0	151	110	9	203.0	120.0	4060	2400	62.9	37.1	67	35.8	58	9	86.5	13.5
8	Jarvis' Golden Prolific	272	293	108	41	416	1.41	27	122	138	6	201.5	124.5	4030	2490	61.9	38.1	70	35.5	58	12	82.8	17.2
9	Boone County White	272	277	108	39	268	.96	32	222	23	0	175.0	113.0	3500	2260	60.8	39.2	64	35.3	52	12	81.2	18.8
10	Latham's Double	272	271	108	48	320	1.18	20	182	69	0	221.0	120.0	4420	2400	64.9	35.1	68	35.2	56	12	82.3	17.7
11	Selection No. 164 (B. P. I.)	272	312	114	51	497	1.59	72	31	161	48	238.0	114.0	4760	2280	67.7	32.3	66	34.5	53	13	80.3	19.7
12	Southern Snow Flake	272	264	114	57	269	1.01	24	211	29	0	237.5	109.5	4750	2190	68.5	31.5	64	34.2	53	11	82.8	17.2
13	Southern Beauty	272	302	112	54	357	1.18	36	177	87	2	210.0	106.0	4200	2120	66.5	33.5	62	34.1	53	9	85.4	14.6
14	Deaton's Favorite	272	246	122	60	233	.94	26	207	13	0	141.0	119.0	2820	2380	54.3	45.7	70	34.0	59	11	84.2	15.8
15	Shenandoah White Dent	272	280	108	40	266	.95	47	200	33	0	174.5	115.5	3490	2310	60.2	39.8	68	33.9	56	12	82.3	17.7
16	Coker's One Ear	272	292	120	63	282	.96	72	158	62	0	212.0	105.0	4240	2100	66.9	33.1	63	33.3	54	9	85.7	14.3
17	Parker's Prolific	272	237	111	54	382	1.61	5	89	136	7	200.0	122.0	4000	2440	62.2	37.8	75	32.5	60	15	80.0	20.0
18	Cocke's Prolific	272	253	108	48	381	1.50	23	84	141	5	174.0	115.0	3480	2300	60.3	39.7	72	31.9	57	15	79.1	20.9
19	White Majestic	272	260	108	60	288	1.11	1	230	29	0	191.0	103.0	3820	2060	65.0	35.0	65	31.6	56	9	86.1	13.9
20	Hickory King	272	263	110	60	318	1.20	8	192	63	0	149.0	104.0	2980	2080	58.9	41.1	66	31.5	56	10	84.8	15.2
21	Wannamaker	272	324	120	54	378	1.16	83	106	133	2	239.0	115.0	4780	2300	67.6	32.4	74	31.0	60	14	81.0	19.0
22	Batts' Four Ear	272	308	120	62	402	1.30	46	127	130	5	224.0	112.0	4480	2240	66.7	33.3	73	30.6	58	15	79.4	20.6
23	Gerrick's Prolific (B. P. I.)	272	306	120	72	395	1.29	83	58	158	7	240.0	104.0	4800	2080	67.7	32.3	68	30.5	55	13	80.8	19.2
24	Blount's Prolific	272	306	114	48	319	1.04	67	160	78	1	171.0	103.0	3420	2060	62.5	37.5	74	27.8	59	15	79.7	20.3

TABLE V.—COMPILED RESULTS OF VARIETY TEST OF CORN—IREDELL TEST FARM.

Rank According to Yield Per Acre in Bushels of Shelled Corn	Varieties	Yield Per Acre													
		1909		1910		1911		1912		1913		1914		Average for Six Years	
		Pounds of Stover	Bushels of Shelled Corn	Pounds of Stover	Bushels of Shelled Corn	Pounds of Stover	Bushels of Shelled Corn	Pounds of Stover	Bushels of Shelled Corn	Pounds of Stover	Bushels of Shelled Corn	Pounds of Stover	Bushels of Shelled Corn	Pounds of Stover	Bushels of Shelled Corn
1	Weekly's Improved	2540	26.5	3930	38.4	3200	39.9	1964	34.3	4738	66.7	2130	33.7	3083	39.9
2	Southern Beauty	1670	30.4	2920	39.4	2460	38.3	2023	32.2	3795	57.6	1890	34.9	2459	38.8
3	Parker's Prolific	1500	34.2	2520	35.2	2540	34.0	2071	41.4	2783	42.7	2085	34.3	2249	36.9
3	Bigg's Seven Ear	1980	26.0	2740	29.0	2700	32.4	3154	45.0	3335	48.8	2160	40.2	2678	36.9
4	Goodman's Prolific	2400	24.2	2940	31.7	2700	31.8	2666	38.0	2484	32.6	2700	36.1	2648	32.6
5	Hickory King	1490	21.5	1880	32.1	2900	34.6	2191	36.2	3289	36.4	1440	26.2	2198	31.1
6	Boone County White	1600	31.0	2270	32.8	2000	35.1	2142	40.3	1702	23.3	1290	20.9	1834	30.5

TABLE VI.—COMPILED RESULTS OF VARIETY TEST OF CORN—EDGECOMBE TEST FARM.

1	Bigg's Seven Ear	2220	41.5	2040	31.9	2080	26.5	2200	21.1	2244	31.1	3030	39.8	2302	31.9
2	Weekley's Improved	2390	40.7	2300	23.3	1590	20.6	1240	19.4	3077	44.9	5190	37.6	2631	31.0
3	Goodman's Prolific	1600	31.5	2800	23.6	1860	26.3	2860	22.0	2686	38.2	4060	35.8	2644	29.5
4	Parker's Prolific	1795	15.6	2480	26.0	1190	23.4	1450	25.0	2414	43.1	4000	32.5	2221	27.6
5	Hickory King	3955	30.0	3660	35.5	2120	24.3	960	19.1	2980	25.0	1853	31.5	2586	27.5
6	Southern Beauty	1810	27.2	2540	31.3	1760	27.6	1750	15.0	1190	22.5	4200	34.1	2208	26.2
7	Boone County White	1310	13.7	2240	25.1	2400	21.4	1460	16.2	1581	23.4	3500	35.3	2081	22.5

SOURCES OF SEED OF VARIETIES OF CORN DURING THE SEASON OF 1914

Variety.	*Source of Seed.*	
1. Biggs' Seven Ear	Noah Biggs	Scotland Neck, N. C.
2. Gerrick's Prolific	Bureau of Plant Industry	Washington, D. C.
3. First Generation Cross No. 182	Bureau of Plant Industry	Washington, D. C.
4. Selection No. 164	Bureau of Plant Industry	Washington, D. C.
5. Parker's Prolific	T. B. Parker	Raleigh, N. C.
6. Southern Beauty	L. S. Strupe	Tobaccoville, N. C.
7. Goodman's Prolific	J. K. Goodman	Mt. Ulla, N. C.
8. Hickory King	T. W. Wood & Sons	Richmond, Va.
9. Columbia Beauty	T. W. Wood & Sons	Richmond, Va.
10. Weekley's Improved Selection No. 35	Iredell Test Farm	Statesville, N. C.
11. Cocke's Prolific	Edgecombe Test Farm	Rocky Mount, N. C.
12. Coker's One Ear	Coker & Co.	Hartsville, S. C.
13. Marlboro Prolific	R. T. Malone	Capleville, Tenn.
14. Eureka	T. W. Wood & Sons	Richmond, Va.
15. Wannamaker	Model Seed Farm	St. Matthews, S. C.
16. Boone County White	T. W. Wood & Sons	Richmond, Va.
17. Blount's Prolific	T. W. Wood & Sons	Richmond, Va.
18. Jarvis' Golden Prolific	J. M. Jarvis	Winston-Salem, N. C.
19. Latham's Double	F. P. Latham	Belhaven, N. C.
20. Deaton's Favorite	Chas. Deaton	Carthage, N. C.
21. Crook's Prolific	Crook's Bros.	Huron, Tenn.
22. Batt's Four Ear	J. F. Batts	Garner, N. C.
23. Shenandoah White Dent	T. W. Wood & Sons	Richmond, Va.
24. White Majestic	T. W. Wood & Sons	Richmond, Va.
25. Southern Snow Flake	T. W. Wood & Sons	Richmond, Va.

EDWARDS & BROUGHTON PRINTING CO., RALEIGH, N. C.

BULLETIN 231 APRIL, 1915

NORTH CAROLINA

AGRICULTURAL EXPERIMENT STATION

CONDUCTED JOINTLY BY THE

STATE DEPARTMENT OF AGRICULTURE

AND THE

COLLEGE OF AGRICULTURE AND MECHANIC ARTS

RALEIGH AND WEST RALEIGH

DIVISION OF AGRONOMY

REPORT ON VARIETY TESTS OF COTTON FOR 1914

Bulletins of the Station Will be Sent Free to Citizens of the State on Request

RALEIGH
EDWARDS & BROUGHTON PRINTING CO.
STATE PRINTERS
1915

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4In coöperation with the U. S. Department of Agriculture, Office of Experiment Stations.

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REPORT ON VARIETY TESTS OF COTTON FOR 1914

By R. Y. Winters, Agronomist in Plant Breeding.

A variety test should, above all things, be of service in predicting the future merit of the varieties tested. The confidence with which prediction can be made depends upon the purity of the seed and the care that has been used in their handling. When one has to deal with mixtures and poorly handled varieties the task seems almost hopeless. Data from mixed varieties of cotton can hardly be used further than to prove the existence of mixtures and to announce the uncertainty of future crops which may come from such seed.

Points to be Considered by Our Cotton Growers.

The value of our seeds as crop producers is dependent upon the care that has been used in their selecting and handling. Observations in the State and results of the variety tests indicate our need of more carefully selected cotton seed.

A large quantity of our cotton is penalized on the market because of its poor quality and lack of uniformity.

Among 65 short staple varieties tested at the Experiment Station Farm, 15 were grown from seed secured in the State. Among these 15 local varieties, three produced lint only three-quarters of an inch in length; six produced lint less than seven-eighths; and six produced lint of seven-eighths of an inch or more. Cotton which produces a uniform lint seven-eighths of an inch or more in length is valued at one-half to two cents more per pound than the shorter lint. The choosing of good varieties followed by a small amount of careful selecting would soon eliminate all of the poor seed in our State.

In addition to improving the quality of lint, we need seed which will also produce a greater yield per acre. The following table indicates the need of improving our locally grown seed.

Average Yields Compared.

	Seed Cotton lbs. per Acre.	*Lint lbs. per Acre.*
For 50 varieties from points out of the State.....	1,072.4	418.5
For 15 varieties from points within the State.....	1,001.2	371.6
Difference in average yields.....	71.2	46.9

The seed secured within the State produced an average yield of 974.6 pounds of seed cotton and 362 pounds of lint, while those from out of the State produced an average yield of 1072.4 pounds of seed cotton and

418.5 pounds of lint per acre. The highest yielding variety from out of the State produced 120 pounds of seed cotton and 84.4 pounds of lint more per acre than the highest yielding local variety. The four varieties which lead in the production of lint per acre came from seed which had been improved by careful selection.

The above results indicate our need of selecting cotton for higher yields and better quality of lint. We need to discard the inferior small boll and cluster varieties now grown in the eastern part of the State and replace them with the best strains of such varieties as Cleveland Big Boll, Russell Big Boll, Culpepper, Hope's Mexican Big Boll, or other closely related varieties. In the Piedmont section and in the rich lowlands we must improve early strains of the small and medium boll varieties such as King, Cook, Toole and others. These varieties must be grown and selected to fit local conditions in order to obtain the best results. Growers who are prepared to do more careful work may grow the long staple varieties to advantage. The long staple upland cotton requires careful selecting each year to retain the quality and uniformity of lint. Growers who are not prepared to do careful selecting should either buy good seed each year or grow short staple cotton. The Station is in a position to recommend good strains of cotton, and will be glad to aid growers who wish to do careful selection work.

Plan of Testing the Varieties.

The cotton seed were divided into long and short staple variety groups and the varieties of these groups were arranged according to size of boll. This arrangement permits the grouping of similar varieties together for comparison, and eliminates the influence which may come from the growing of large and small varieties in neighboring rows. At the Experiment Station Farm, check rows were included after each six varieties tested, and at the Edgecombe and Iredell Test Farms check rows were used after each ten varieties. The check rows at each of the farms were so uniform that it was not necessary to make corrections for yields. The data contained in the tables below represent actual results. For determining the length of staple, size of boll, and per cent of lint, fifty representative bolls were taken from each variety just before each picking. The bolls were taken from several plants of the row in order to secure a representative sample. Each sample was carefully ginned by a small roller gin. These composite samples were carefully weighed and measured to determine the per cent of lint and length of staple.

Experiment Station Farm.

The Station Farm is located about two miles west of Raleigh, and the soil represents the sandy clay loam of the Piedmont section. This test contained 65 short staple varieties and 12 long staple varieties of cotton. Each variety was given one-twentieth of an acre and a check plat was included after each six plats of varieties. The short and long staple

varieties have been grouped in separate tables, but may be compared with each other direct since all of the varieties received the same treatment.

The following tables contain a list of the varieties and data arranged in order of value of lint and seed per acre.

TABLE I—VARIETIES OF SHORT STAPLE COTTON GROWN IN 1914, RANKED ACCORDING TO VALUE OF SEED AND LINT PER ACRE.

Experiment Station Farm.

Variety and Source of Seed	Yield of Seed Cotton, Pounds Per Acre	Pounds of Seed Cotton, Per Acre, First Picking.	Yield of Lint, Pounds Per Acre	Yield of Seed, Pounds Per Acre	Percent of Lint	Length of Staple	Weight of 100 Bolls, Ounces	Actual Number Stalks, Per Plat	Number of Stalks for Perfect Stand, Per Plat
Sunbeam, Georgia Experiment Station	1,375	410	536.2	838.8	39	7/8	24.1	198	341
Cleveland 310, Alabama Experiment Station	1,340	305	536.0	804.0	40	7/8	22.7	313	341
Wanamaker's Pedigreed Cleveland Big Boll, Modern Seed Farm, St. Matthews, S. C.	1,300	310	520.0	780.0	40	7/8+	22.9	300	341
Cook's 609, Alabama Experiment Station	1,165	410	524.2	640.8	45	7/8	21.9	394	341
Crawford's Improved Big Boll, T. A. Crawford, Williston, Tenn.	1,260	245	491.4	768.6	39	7/8	27.0	314	341
Summerour's Half and Half, H. H. Summerour, Duluth, Ga.	1,095	485	525.6	569.4	48	7/8—	23.0	389	341
Peterkin, Jasper Fletcher, McColl, S. C.	1,205	265	494.0	711.0	41	7/8—	19.7	319	341
Hite's Early Prolific, W. T. Hite, Augusta, Ga.	1,195	325	490.0	705.0	41	7/8	16.8	345	341
Triumph, Excelsior Seed Farm, Cheraw, S. C.	1,245	410	485.6	759.4	39	7/8	23.1	374	341
Cleveland Big Boll, Excelsior Seed Farm, Cheraw, S. C.	1,220	350	475.8	744.2	39	7/8	21.1	320	341
Jones Re-Improved Cook, R. P. Jones, Ellaville, Ga.	1,150	380	483.0	667.0	42	3/4+	23.1	376	341
Dongola, Excelsior Seed Farm, Cheraw, S. C.	1,195	350	466.0	729.0	39	7/8	22.8	318	341
Covington-Toole Wilt Resistant, No. 25, W. F. Covington, Headland, Ala.	1,145	280	469.5	675.5	41	7/8+	18.6	333	341
Cleveland Big Boll, W. T. Brooks, Arlington, Ga.	1,170	305	456.3	713.7	39	7/8	26.8	261	341
Shine's Early Prolific, J. A. Shine, Faison, N. C.	12.55	640	451.8	803.2	36	7/8	15.0	322	341

Hope's Mexican Big Boll, J. D. Hope, Sharon, S. C.	1,140	520	456.0	684.0	40	7/8+	24.0	325	341
Wannamaker's Pedigreed Toole, Modern Seed Farm, St. Matthews, S. C.	1,075	350	462.3	612.7	43	3/4+	21.0	296	341
Hawkins's Extra Prolific, B. W. Hawkins, Eatonton, Ga.	1,175	335	446.5	728.5	38	3/4+	17.2	361	341
Dixie, Bureau of Plant Industry	1,200	290	432.0	768.0	36	7/8—	19.7	327	341
Braddy, L. C. Braddy, Dillon, S. C.	1,155	290	438.9	716.1	38	7/8—	18.8	285	341
Culpepper's Re-Improved, J. E. Culpepper, Luthersville, Ga.	1,190	270	428.4	761.6	36	7/8+	21.0	304	341
Cleveland Big Boll, J. R. Cleveland, Decatur, Ga.	1,125	235	438.7	686.3	39	7/8	22.1	316	341
Truitt's Improved, G. W. Truitt, LaGrange, Ga.	1,150	250	425.5	724.5	37	7/8	23.8	337	341
Money Maker, Alexander Seed Co., Augusta, Ga.	1,055	325	443.1	611.9	42	7/8	16.9	364	341
Bradbury's Improved, J. E. Bradbury, Jr., & Sons, Athens, Ga.	1,080	290	442.8	637.2	41	7/8	25.2	309	341
Russell Big Boll, Edgecombe Test Farm, Rocky Mount, N. C.	1,160	380	417.6	742.4	36	7/8+	20.6	313	341
Brown No. 1, M. L. Brown, Decatur, Ga.	1,075	260	430.0	645.0	40	7/8+	24.1	312	341
Mortgage Lifter, H. G. Hastings Seed Co., Atlanta, Ga.	1,105	340	419.9	685.1	38	7/8+	24.6	338	341
Rosser's No. 1, H. G. Hastings Seed Co., Atlanta, Ga.	1,190	620	404.6	785.4	34	7/8	18.9	352	341
Sunbeam, J. T. Dennis, Elberton, Ga.	1,105	135	419.9	685.1	38	7/8+	23.9	378	341
Dauble Header, R. H. Smith, Monticello, Ga.	1,150	330	402.5	747.5	35	1	26.0	351	341
Toole, W. W. Toole, Augusta, Ga.	1,030	310	420.3	609.7	41	7/8—	17.9	287	341
Covington-Toole Wilt Resistant No. 26, W. F. Covington, Headland, Ala.	1,060	225	413.4	646.6	39	7/8	17.0	328	341
Moss Improved, A. B. Moss, Norway, S. C.	980	365	421.4	558.6	43	7/8—	18.1	323	341

TABLE I—*Continued.*

Variety and Source of Seed	Yield of Seed Cotton, Pounds Per Acre	Pounds of Seed Cotton, Per Acre, First Picking	Yield of Lint, Pounds Per Acre	Yield of Seed, Pounds Per Acre	Percent of Lint	Length of Staple	Weight of 100 Bolls, Ounces	Actual Number Stalks, Per Plat	Number of Stalks for Perfect Stand, Per Plat
Wine Sap, R. H. Gower, Clayton, N. C.	1,100	600	396.0	704.0	36	7/8—	15.3	359	341
Ricks Improved, R. H. Ricks, Rocky Mount, N. C.	1,075	320	397.8	677.2	37	7/8—	18.9	339	341
Triumph Improved, R. T. Malone, Capleville, Tenn.	1,030	210	401.7	628.3	39	7/8—	23.2	319	341
Trice, J. F. Bridger, Bells, Tenn.	1,085	730	390.6	694.4	36	7/8	16.9	361	341
Triumph Improved, R. T. Malone, Capleville, Tenn.	1,025	460	399.7	625.3	39	7/8	23.0	342	341
Prize, W. B. Lewis, Lewiston, La.	1,020	280	397.8	622.2	39	7/8	17.2	350	341
Bank Account, H. G. Hastings Seed Co., Atlanta, Ga.	1,050	480	388.5	661.5	37	3/4+	16.7	344	341
Christopher Improved, R. L. Christopher, LaGrange, Ga.	1,030	235	391.4	638.6	38	7/8+	23.4	310	341
Broadwell's Double Jointed, J. B. Broadwell, Alpharetta, Ga.	1,030	500	319.4	638.6	38	7/8—	15.2	325	341
Langford's Big Boll, W. S. Sanders, Danielsville, Ga.	1,020	235	387.6	632.4	38	7/8	23.4	315	341
Simpkins Big Boll, W. A. Simpkins, Raleigh, N. C.	965	245	395.6	569.4	41	7/8	25.2	317	341
Uncle Sam, J. A. Wade, Alexander City, Ala.	975	270	390.0	585.0	41	1 —	24.6	390	341
Carolina Gem, R. W. Powell, Wadesboro, N. C.	995	335	388.0	607.0	40	7/8—	14.5	309	341
Willett's Red Leaf, N. L. Willett Seed Co., Augusta, Ga.	975	330	380.3	594.7	39	7/8—	18.0	343	341
Upright Cotton, H. G. Hastings Seed Co., Atlanta, Ga.	1,000	330	370.0	630.0	37	7/8—	21.1	340	341

Texas Black Wood, H. M. N. Watson, Red Springs, N. C.	915	210	366.0	549.0	40	7/8	13.2	298	341
Kings' Improved, Iredell Test Farm	975	660	360.7	614.3	37	3/4+	16.3	352	341
Texas Burr, C. E. Smith, Locust Grove, Ga.	995	265	358.2	636.8	36	7/8+	24.0	368	341
Thigpen's Prolific, I. L. Thigpen, Conetoe, N. C.	1,015	190	345.1	669.9	34	1	23.1	335	341
Perry's Improved, Miley Perry, Raleigh, N. C.	895	570	366.9	528.1	40	7/8—	13.7	344	341
Mitchell's Early Prolific, Sugar Loaf Cotton Farm, Youngsville, N. C.	930	520	353.4	576.6	38	3/4+	16.0	318	341
Allen's Multiplier, N. J. Allen, Clayton, N. C.	950	520	351.0	598.5	37	3/4	15.4	339	341
Dillon Wilt Resistant, Bureau Plant Industry	880	200	360.8	519.2	41	7/8+	16.7	307	341
Perfect Bred Sugar Loaf, Sugar Loaf Cotton Farm, Youngsville, N. C.	905	580	343.9	561.1	38	7/8+	16.0	328	341
Truitt's Ninety-Day, J. G. Truitt, Lagrange, Ga.	940	360	347.8	529.2	37	7/8	17.2	310	341
Trice, J. F. Bridger, Bells, Tenn.	925	410	333.0	592	36	7/8	16.9	316	341
Wine Sap (Topped), R. H. Gower, Clayton, N. C.	925	510	333	592.0	36	7/8—	14.9	307	341
Dozier's Improved, M. D. Dozier, Camden, N. C.	860	560	309.6	550.4	36	7/8—	15.9	342	341
King Triumph Hybrid, Alabama Experiment Station	780	360	312.0	468.0	40	7/8	23.9	296	341
Spring Grove, S. A. Brown, Cross Hill, S. C.	765	350	298.4	466.6	39	3/4+	16.0	278	341

TABLE II—VARIETIES OF LONG STAPLE COTTON GROWN IN 1914, RANKED ACCORDING TO VALUE OF LINT AND SEED PER ACRE.

Experiment Station Farm.

Variety and Source of Seed	Yield of Seed Cotton, Pounds Per Acre	Pounds of Seed Cotton, First Picking, Per Acre	Yield of Lint, Pounds Per Acre	Yield of Seed, Pounds Per Acre	Percent of Lint	Length of Staple	Weight of 100 Bolls, Ounces	Actual Number Stalks, Per Plat	Number of Stalks for Perfect Stand, Per Plat
Keenan, W. B. Lorance, Columbia, S. C.	1,160	190	406.0	754.0	35	1⅛+	23.6	295	341
Keenan (Goodson) Pedigreed Seed Co., Hartsville, S. C.	1,130	105	406.8	723.2	36	1 3-16—	21.0	332	341
Columbia, D. J. Griffith, Columbia, S. C.	1,115	370	390.0	725.0	35	1⅛+	22.2	333	341
Columbia, Oscar Hagga, Memphis Tenn.	1,115	430	390.3	724.7	35	1⅛	20.4	261	341
Acme, A. M. Huggins, Lamar, S. C.	1,060	290	349.8	710.2	33	1 3-16	18.6	298	341
Piedmont Long Staple, Hickory Seed Co., Hickory, N. C.	1,015	400	345.1	669.9	34	1⅛	19.2	308	341
Keenan, R. C. Keenan, Columbia, S. C.	990	120	356.4	633.6	36	1 3-16—	24.0	355	341
Improved Peeler, Napier Bros. Seed Farm, Blenheim, S. C.	1,020	270	326.4	693.6	32	1¼	16.8	397	341
Hartsville No. 7, Pedigreed Seed Co., Hartsville, S. C.	945	200	340.2	604.8	36	1⅛	31.0	295	341
Webber Pedigreed Seed Co., Hartsville, S. C.	885	205	288.8	536.2	35	1 3-16+	23.0	307	341
Lewis Long Staple, E. P. Lewis, Gastonia, N. C.	852	310	272.6	579.4	32	1 3-16	17.8	364	341
Allen's Early J. B. Allen, Port Gibson, Miss.	875	165	262.5	612.5	30	1¼+	15.7	278	341

In determining the rank of varieties no account has been taken of quality and length of staple for individual varieties. A uniform price has been set for all short staple varieties and another for all long staple varieties.

SUMMARY OF RESULTS.

At the Experiment Station Farm, 65 varieties of short staple and 12 varieties of long staple cotton were tested. Fifteen of the short staple varieties and three of the long staple cottons came from growers within the State. The 65 varieties of short staple cotton ranged in yield between 1375 and 765 pounds of seed cotton per acre. These varieties gave an average yield of 1023 pounds of seed cotton per acre. The fifteen varieties secured within the State ranged in yield between 1160 and 860 pounds of seed cotton per acre, giving an average yield of 974 pounds of seed cotton per acre. The results indicate the need of more careful selecting of seed in the State.

The 12 long staple varieties ranged in yield between 1160 and 875 pounds of seed cotton per acre, giving an average yield of 1009 pounds of seed cotton per acre.

Edgecombe Test Farm.

The Edgecombe Test Farm is located in the central portion of Edgecombe County and its soil represents the Norfolk Sandy Loam of the eastern part of the State.

The test at the Edgecombe farm contained 16 short staple varieties and 5 long staple varieties of cotton. Of the 16 short staple varieties tested, 10 were secured from points within the State.

The following tables contain a list of the varieties and data arranged according to the value of lint and seed per acre.

TABLE III—VARIETIES OF SHORT STAPLE COTTON GROWN IN 1914, RANKED ACCORDING TO VALUE OF LINT AND SEED PER ACRE.

Edgecombe Test Farm.

Variety and Source of Seed	Yield of Seed Cotton, Pounds Per Acre	Pounds of Seed Cotton, First Picking Per Acre	Yield of Lint, Pounds Per Acre	Yield of Seed, Pounds Per Acre	Percent of Lint	Length of Staple	Weight of 100 Bolls, Ounces	Actual Number Stalks, Per Plat	Number of Stalks for Perfect Stand, Per Plat
Wannamaker Storm-Proof Big Boll Toole, Modern Seed Farm, St. Matthews, S. C.	1,305	1,160	548.1	756.9	42	7/8	21.0	434	363
Crawford's Improved Big Boll, T. A. Crawford, Williston, Tenn.	1,315	1,200	512.9	802.1	39	7/8	23.1	464	363
Wannamaker's Pedigreed Cleveland Big Boll Modern Seed Farm, St. Matthews, S. C.	1,220	1,100	500.2	719.8	41	7/8	21.0	444	363
Russell's Big Boll, Edgecombe Test Farm, Rocky Mount, N. C.	1,310	1,100	471.6	838.4	36	7/8	19.7	312	363
Shine's Early Prolific, J. A. Shine, Faison, N. C.	1,310	1,020	458.5	851.5	35	7/8	17.9	429	363
Lewis Prize, W. B. Lewis, Lewiston, La.	1,220	1,120	475.8	744.2	39	7/8	17.5	442	363
Ricks Improved, R. H. Ricks, Rocky Mount, N. C.	1,250	1.140	462.5	787.5	37	7/8	19.0	446	363
Thigpen's Prolific, I. L. Thigpen, Conetoe, N. C.	1,250	1,100	450.0	800.0	36	1	22.6	425	363
Covington Toole Wilt Resistant No. 26, W. F. Covington, Headland, Alabama	1,135	980	442.7	692.3	39	3/4+	17.7	467	363
Carolina Gem, R. W. Powell, Wadesboro, N. C.	1,105	920	442.0	663.0	40	7/8—	14.5	432	363
Langford's Big Boll, W. S. Sanders, Danielsville, Ga.	1,140	1,000	433.2	756.8	38	7/8	24.0	434	363
Perry's Improved, Miley Perry, Raleigh, N. C.	1,045	920	418.0	627.0	40.0	3/4	17.0	423	363
King's Improved, Iredell Test Farm, Statesville, N. C.	1,115	1,040	368.0	747.0	33	3/4—1	18.1	426	363
Money Maker, Alexander Seed Co., Augusta, Ga.	1,005	940	392.0	603.0	40	7/8	18.1	487	363

King's Improved, Edgecombe Test Farm, Rocky Mount, N. C.	870	760	339.3	530.7	39	¾	16.0	378	363
Perfect Bred Sugar Loaf, Sugar Loaf Seed Farm, Youngsville, N. C.	870	860	320.6	539.4	38	¾	14.6	408	363

TABLE IV—VARIETIES OF LONG STAPLE COTTON GROWN IN 1914, RANKED ACCORDING TO VALUE OF LINT AND SEED PER ACRE.

EDGECOMBE TEST FARM.

Variety and Source of Seed	Yield of Seed Cotton, Pounds Per Acre	Pounds of Seed Cotton, First Picking, Per Acre	Yield of Lint, Pounds Per Acre	Yield of Seed, Pounds Per Acre	Percent of Lint	Length of Staple	Weight of 100 Bolls, Ounces	Actual Number Stalks, Per Plat	Number of Stalks for Perfect Stand, Per Plat
Keenan-Goodson, Pedigreed Seed Co., Hartsville, S. C.	1,520	1,080	547.2	972.8	36	1⅛	27.3	489	363
Hartsville No. 7, Pedigreed Seed Co., Hartsville, S. C.	1,340	960	482.4	857.6	36	1⅛	24.0	407	363
Allen's Early, J. B. Allen, Fort Gibson, Miss.	1,440	1,140	446.4	993.6	31	1¼	15.9	392	363
Webber, Pedigreed Seed Co., Hartsville, S. C.	1,070	920	374.5	695.5	35	1 3-16	24.6	456	363
Lewis Long Staple, E. P. Lewis, Gastonia, N. C.	1,045	880	313.5	731.5	30	1 3-16	21.5	478	363

SUMMARY OF RESULTS.

At the Edgecombe Farm 16 short staple varieties and 5 long staple varieties were included in the test. The short staple varieties ranged in yield between 1305 and 870 pounds of seed cotton per acre, producing an average yield of 1154 pounds of seed cotton per acre. The 10 short staple varieties from points within the State ranged in yield between 1,310 and 870 pounds of seed cotton per acre. These varieties gave an average yield of 1,113 pounds of seed cotton per acre. The six varieties from points out of the State ranged in yield between 1,305 and 1,140 pounds of seed cotton per acre. These gave an average yield of 1,222 pounds of seed cotton and 485 pounds of lint or an average of 109 pounds of seed cotton and 73 pounds of lint more than the varieties secured in the State. The long staple cottons ranged in yield between 1,520 and 1,045 pounds of seed cotton, giving an average yield of 1,283 pounds of seed cotton per acre.

Iredell Test Farm.

The Iredell Test Farm is located at Statesville near the western limit of the cotton growing area of the State. The soil at this farm represents the Cecil Clay of the Piedmont section. On account of the short growing season, the early maturing varieties are best adapted to this section of the State.

In this test 25 short staple varieties and 8 long staple varieties were grown. Nine of the short staple varieties came from seed secured in the State.

The following tables include the varieties and data arranged according to the value of their lint and seed per acre.

TABLE V—VARIETIES OF SHORT STAPLE COTTON GROWN IN 1914, RANKED ACCORDING TO VALUE OF LINT AND SEED PER ACRE.

IREDELL TEST FARM.

Variety and Source of Seed	Yield of Seed Cotton, Pounds Per Acre	Yield of Lint, Pounds Per Acre	Yield of Seed, Pounds Per Acre	Percent of Lint	Length of Staple	Weight of 100 Bolls, Ounces	Actual Number Stalks, Per Plat	Number of Stalks for Perfect Stand, Per Plat
King's Improved, Iredell Test Farm, Statesville, N. C.	870	339.3	530.7	39	¾—1	14.4	324	363
Shine's Early Prolific, J. A. Shine, Faison, N. C.	870	313.2	556.8	36	⅞	16.3	415	363
Wine Sap, R. H. Gower, Clayton, N. C.	840	310.8	529.2	37	¾+	15.3	377	363
King's Improved, Edgecombe Test Farm, Rocky Mount, N. C.	810	324.0	486	40	⅞	17.4	387	363
Crawford's Improved Big Boll, T. A. Crawford, Williston, Tenn.	795	318.0	477.0	40	1 —	24.0	359	363
Perfect Bred Sugar Loaf, Sugar Loaf Cotton Farm, Youngsville, N. C.	803	313.0	490.0	39	¾+	15.0	390	363
Spring Grove Cotton, S. A. Brown, Cross Hill, N. C.	780	312.0	468.0	40	¾+	15.4	358	363
Perry's Improved, Miley Perry, Raleigh, N. C.	765	313.7	451.3	41	¾+	15.5	392	363
Cleveland Big Boll, Excelsior Seed Farm, Cheraw, S. C.	773	301.0	472.0	39	1 —	20.0	303	363
Mitchell's Early Prolific, Sugar Loaf Seed Farm, Youngsville, N. C.	735	286.7	448.3	39	⅞	14.4	410	363
Wannamaker's Pedigreed Cleveland Big Boll, Modern Seed Farm, St. Matthews, S. C.	675	276.8	398.2	41	1 —	23.7	292	363
Prize, W. B. Lewis, Lewiston, La.	690	269.1	420.9	39	⅞	17.5	440	363
Trice, J. F. Bridger, Bells, Tenn.	728	255.0	473.0	35	⅞	19.5	384	363

TABLE V—*Continued.*

Variety and Source of Seed	Yield of Seed Cotton, Pounds Per Acre	Per Acre of Lint, Pounds Yield	Yield of Seed, Pounds Per Acre	Percent of Lint	Length of Staple	Weight of 100 Bolls, Ounces	Actual Number Stalks, Per Plat	Number of Stalks for Perfect Stand, Per Plat
Brown No. 1, M. L. Brown, Decatur, Ga.	645	258.0	387.0	40	7/8+	33.0	385	363
Langford's Big Boll, W. S. Sanders, Danielsville, Ga.	623	250.0	373.0	40	1	27	414	363
Culpepper's Re-Improved, J. E. Culpepper, Lutherville, Ga.	645	245.1	399.9	38	1 —	23.8	351	363
Moss Improved, A. B. Moss, Norway S. C.	585	263.3	321.7	45	7/8	15.7	386	363
Cleveland Big Boll, J. R. Cleveland, Decatur, Miss.	570	233.7	336.3	41	1 —	24.5	298	363
Christopher's Improved, R. L. Christopher, LaGrange, Ga.	585	228.2	356.8	39	7/8	28.6	294	363
Hite's Early Prolific, W. T. Hite, Augusta, Ga.	518	207.0	311.0	40	7/8+	16.6	360	363
Thigpen's Prolific, I. L. Thigpen, Conetoe, N. C.	510	198.9	311.1	39	7/8+	23.7	389	363
Covington-Toole Wilt Resistent No. 25, W. F. Covington, Headland, Ala.	480	196.8	283.2	41	7/8+	17.7	399	363
Carolina Gem, R. W. Powell, Wadesboro, N. C.	443	191.0	252.0	43	3/4+	16.2	433	363
Wannamaker's Storm Proof Toole, Modern Seed Farm, St. Matthews, S. C.	413	178	235	43	7/8+	20.8	347	363
Triumph Improved, R. T. Malone, Capleville, Tenn.	390	144.3	245.7	37	7/8+	19.6	304	363

TABLE VI—VARIETIES OF LONG STAPLE COTTON GROWN IN 1914, RANKED ACCORDING TO VALUE OF LINT AND SEED PER ACRE.

IREDELL TEST FARM.

Variety and Source of Seed	Yield of Seed Cotton, Pounds Per Acre	Yield of Lint, Pounds Per Acre	Yield of Seed, Pounds Per Acre	Percent of Lint	Length of Staple	Weight of 100 Bolls, Ounces	Actual Number Stalks, Per Plat	Number of Stalks for Perfect Stand, Per Plat
Acme,								
A. M. Huggins, Lamar, S. C.	825	297.0	528.0	36	1⅛+	19.9	277	363
Allen's Early,								
J. B. Allen, Port Gibson, Miss.	788	260.0	528.0	33	1⅜+	16.0	350	363
Piedmont Long Staple,								
Hickory Seed Co., Hickory, N. C.	765	237.2	527.8	31	1 3-16—	17.6	380	363
Hartsville No. 7,								
Pedigreed Seed Co., Hartsville, S. C.	525	189.0	336.0	36	1⅛+	27.0	328	363
Columbia Big Boll—Upland,								
D. J. Griffith, Columbia, S. C.	533	176.0	357.0	33	1⅛	22.6	350	363
Keenan (Goodson),								
Pedigreed Seed Co., Hartsville, S. C.	465	172.0	293.0	37	1⅛	24.0	297	363
Lewis Long Staple,								
E. P. Lewis, Gastonia, N. C.	510	168.3	341.7	33	1 3-16	20.2	400	363
Webber,								
Pedigreed Seed Co., Hartsville, S. C.	375	131.3	243.7	35	1¼+	25.0	397	363

SUMMARY OF RESULTS.

The variety test at the Iredell Farm contained 25 short staple varieties and 8 long staple varieties of cotton. Among the 33 varieties were 9 short and 2 long staple varieties which came from points in the State. Short staple varieties from out of the State gave an average yield of 618.4 pounds of seed cotton and 246 pounds of lint per acre compared with 738 pounds of seed cotton and 288 pounds of lint per acre for the locally grown varieties. The four leading varieties are from seed secured in the State. Four of the nine local varieties produced lint less than seven-eights of an inch in length.

The above results show the importance of early maturing varieties for this section and indicate the need of more careful selecting to improve the quality of yield of lint.